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ELECTRICAL WORLD

JULY 11, 1931
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A consolidation of Electrical World, Electrical Engineer and American Electrician

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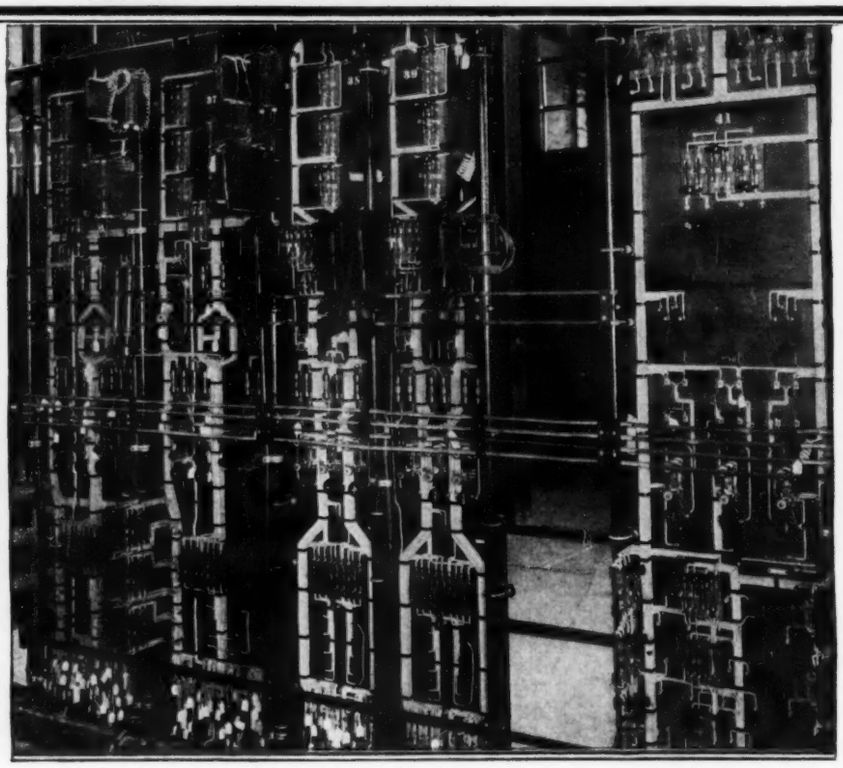
THE JOB THAT MUST BE PERFECT



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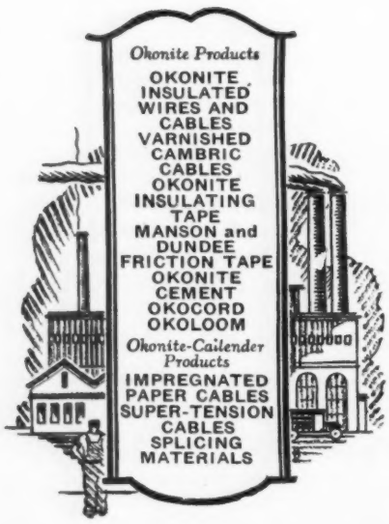

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ELECTRICAL WORLD

for the Week Ending

July 11, 1931

Massachusetts commissioner firm against extension of regulation

The most obvious improvement of the present system of regulation would be the doing away with extended legal contests and the substitution of voluntary action on the part of the utilities whereby rate adjustments may be put into effect.

LEON O. WHITSELL,
California Railroad Commissioner.

—**Forget the holding company,** says Chairman Attwill of the Massachusetts Department of Public Utilities, who sees the quality of the management of properties more important than supervision of stockholders—*p. 73.*

—**Oil-blast phenomena analyzed** by engineer who views divergent theories as reducible to elementary principles. Five variants considered in design of oil circuit breakers and a rational relationship developed for each—*p. 56.*

Federal Power Commission to investigate

—**Hydro licensees to be probed** by the board which authorized their activities. To duplicate Federal Trade hearings? Will a policy involving future licensing develop? Of many investigations there is no end—*p. 47.*

—**Modernization brings benefits** is plea of credit company representative, who points out the relationship between electrical industry prosperity and that of energy consumers and equipment buyers—*p. 69.*

—**Industrial research neglected** is view of Dean Whitehead of the engineering department of Johns Hopkins. While scientific research has proceeded encouragingly, industry has not done its co-operative bit—*p. 63.*

—**Welding sequences important** in avoidance of contraction stresses. Southern California Edison Company establishes desiderata for best results in structural-steel fabrication in its new earthquake-proof home—*p. 68.*

—**Water heating wins in Maine.** Here low-wattage continuous service averages $5.10 a month revenue. Installations made in period of twenty months total 620 on property of Central Maine Power Company—*p. 75.*

—**Mississippi transmission span** is notable, not for the width of the river crossing, but for the speed of conductor placement. Four days to string six conductors and two ground wires elevated throughout a mile—*p. 66.*

International High-Tension Congress meets

Paris Conference on High-Tension Systems Again Scores a Success

MORE than 100 papers were presented at the sixth biennial International Conference on Large Electrict High-Tension Systems, which was held in Paris from June 18 to 27. M. Deligne, French Minister of Public Works, opened the session. Attendance totaled 725, compared with 703 at the previous conference, held in 1929, and with 200 at the first international meeting in 1921. Delegates of 32 countries were in attendance, including fourteen Americans. Conference business and the reading of papers were in two languages, French and English, and during the ten days of the meeting there was no little discussion and comment from the floor.

One of the most interesting sessions concerned lightning problems. Difference of opinion and observation developed, as between American and European methods of protection, and the results of the continued research will be awaited in the expectation that experience will eventually bring a large degree of uniformity.

In a paper on insulation of some of the higher-voltage lines, A. O. Austin, chief engineer Ohio Insulator Company and consulting engineer Ohio Brass Company, discussed, among other things, conductor heights, the effect of polarity and height upon direct lightning strokes, increasing flashover by the efficient use of tower clearances, the use of high ground wires, span lengths, station insulation, radio interference and "high ultimate" porcelain insulators.

Two papers of somewhat unusual character were presented by E. Schjölberg-Henriksen of Norway and S. Viel of France respectively The former dealt with high-tension direct-current transmission and the latter with the theoretical design of a 400-kv. network.

Eight papers dealt with the use of insulating oils and six papers with oil circuit breakers. Insulation methods and problems occupied a good portion of the conference's time, the report of the insulation committee being particularly well prepared and containing the contributions of a large number of collaborators as well as the results of elaborate original research work in the testing of all known types of insulation. Other topics included parallel operation of central stations, cables, reactive power, grounding the neutral, overvoltage, alternators, transformers, aërial conductors, automatic and distant control, inductive co-ordination, voltage transformation, technical and commercial considerations in interconnection, and power-factor problems.

Marcel Ulrich, president of the Syndicate of Producers and Distributors of Electrical Energy (France), was re-elected president of the conference for the coming two years. The United States gained a new vice-president, Frederic Attwood, vice-president Ohio Brass Company, who was the official American government delegate. H. W. Young, president Delta-Star Electric Company, of Chicago, was re-elected as a vice-president.

Besides Messrs. Young and Attwood, the American members at the conference were A. O. Austin, chief engineer Ohio Insulator Company; Maurice A. Henriod, European engineer for the Ohio Brass Matériel Electrique; T. J. Little, Anaconda Wire & Cable Company, New York; W. W. Lewis, F. W. Peek, K. B. McEachron and R. M. Spurck, General Electric Company; Philip Sporn, chief electrical engineer American Gas & Electric Company; John M. Grzybowski, Westinghouse Electric & Manufacturing Company; R. B. Young, Atlantic Refining Company, and Paul Testard and Marc Wood-Billetoux of Paris. The American group submitted seven papers to the conference.

An association has been organized to carry on the activities of the conference and to represent more clearly what has hitherto been termed its bureau or office. Associations, schools, public and private organizations will be admitted as collective members, in addition to the industrial and commercial groups and the individual members. Members of the association will receive the conference's monthly review, *Electra*, a new publication.

▼

EXPLAINS PHOTO-ELECTRIC CELL TO OFFICERS

L. W. Chubb, Westinghouse research man, shows two military men the advantages of the "electric eye" in the control of traffic, particularly at intersections of main thoroughfares with roads where travel is light.

Niagara-Hudson-New York Interconnection up Again

DEMAND BY THE New York Public Service Commission for additional information respecting the tie-in between the New York Edison Company and the Niagara-Hudson power system has caused delay in the final authorization of the project, although work has been proceeding on the upper end of the line, between East Greenbush and Hudson, which will form the first "leg" of the interconnection.

At a hearing on Wednesday of this week it was testified that the proposed interconnection would enable the New York Edison to draw on the New York Power & Light for peak reserve capacity and thereby save investment in a 160,000-kw. steam unit within the next two years, while at the same time surplus hydro power from the New York Power & Light would find a market and the latter system could get steam power from the metropolis during low-water periods, without which it also would have to build a steam plant in two years, of 50,000 kw. capacity. The cost of the tie line, about $7,500,000, would be prorated between the companies. Another double-circuit tower line could eventually be built on the right-of-way, and the rating of terminal equipment also could be increased.

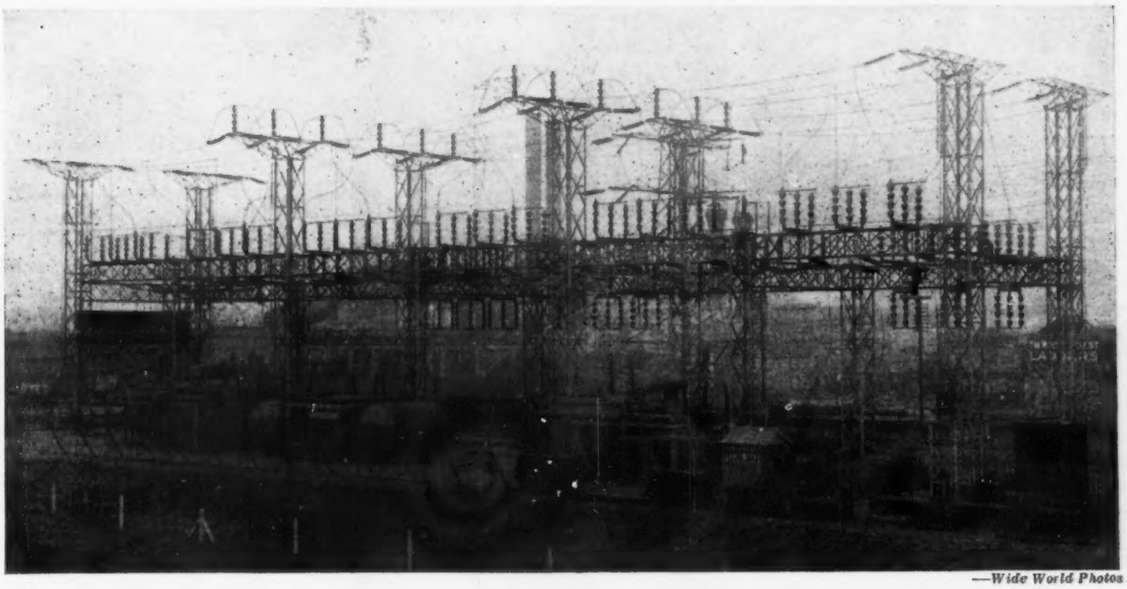
Otto Snyder, president New York Power & Light Company, and H. R. Woodrow, secretary of the technical advisory committee of the New York Edison Company, testified.

▼

Swasey Makes New Gift to Engineering Foundation

AMBROSE SWASEY, founder of the engineering Foundation, has added $250,000 to his previous gifts to that body, bringing their total to $750,000. Mr. Swasey made his gift known last week at a dinner at the University Club, New York, given by Chairman H. Hobart Porter

INTERBOROUGH 132-KV. SUBSTATION IN SOUTHERN BRITISH "GRID"



—*Wide World Photos*

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of the Foundation, at which Mr. Swasey was the guest of honor. There were present also more than 30 presidents and former presidents of national engineering societies, of the United Engineering Trustees and of the Engineering Foundation, besides other nationally prominent engineers.

Mr. Swasey, born at Exeter, N. H., nearly 85 years ago, is the surviving member of the firm of Warner & Swasey of Cleveland, famous for the building of great telescopes and of instruments and machine tools of precision. The Engineering Foundation was founded in 1914 on the basis of his conception of a research instrumentality for the profession of engineering and for broad services to mankind. It was established by the national societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers.

▼

D. C. Jackson Gets Lamme Medal at S.P.E.E. Session

BESTOWAL OF THE Lamme medal for achievement in the field of engineering education upon Dugald C. Jackson, professor of electrical engineering at the Massachusetts Institute of Technology, was an event at the recent convention at Purdue University, Lafayette, Ind., of the Society for the Promotion of Engineering Education.

Officers for the new term were elected as follows: President, H. S. Evans, University of Colorado, Boulder; vice-presidents, H. H. Jordan, University of Illinois, Urbana, and D. S. Anderson, Tulane University, New Orleans; secretary, F. L. Bishop, University of Pittsburgh; treasurer, W. O. Wiley, New York; assistant secretary, Nell McKenry, University of Pittsburgh. This will be Mr. Wiley's twenty-fourth term as treasurer and Mr. Bishop's eighteenth as secretary.

The 1932 meeting will be held at Oregon State College, Corvallis, Ore., in the middle of July.

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Ontario Hydro Speakers Make Vigorous Defense

CONFIDENCE IN THE POLICY of the Ontario Hydro-Electric Power Commission was expressed in a resolution adopted at the joint convention of the Association of Municipal Electrical Utilities and the Ontario Municipal Electrical Association held in Ottawa June 25 to 27. The immediate development of the St. Laurence River as a future source of power was urged in another resolution adopted.

Trenchant criticism of those attacking the Hydro was made by C. Alfred Maguire of Toronto, new vice-chairman of the commission and also president of the Ontario Municipal Electrical Association, who declared that the attacks were a deliberate attempt to bring disaster on the system, and also by F. A. Gaby, chief engineer of the commission.

Premier Henry of Ontario denied making Hydro a political issue. J. R. Cooke, new chairman of the commission, asserted that there is but 525,000 hp. to be absorbed by the province within the next five years. For that reason it had been advisable to purchase 795,000 hp., of which 268,000 hp. has already been absorbed.

Federal Power Board to Make Own Investigation

CHAIRMAN GEORGE OTIS SMITH of the Federal Power Commission announces that the commission has started a fact-finding study following adoption of the following resolution:

That, for the purpose of obtaining the facts needed by the Federal Power Commission in carrying on its functions prescribed by the federal water-power act, a study be authorized of the ownership, control and affiliations of the public utility operating companies which are licensees of the Federal Power Commission, and that this study shall include the collection of all available facts bearing upon the ownership and control, direct or indirect (through stock ownership or control or otherwise), of stock, security or capital interest of public utilities engaged in the developing, transmitting or distributing of hydro-electric power for sale or use in the public service where the same enters into interstate business, or where the same or any part thereof shall be subject to regulation by the Federal Power Commission under the jurisdiction conferred by the federal water-power act, by holding companies, investment trusts, individuals, partnerships, corporations, associations and trusts, and the organization, financing, development, management, operation and control of such holding companies, investment trusts, partnerships, corporations, associations and trusts.

For the purpose of making the foregoing study the employment of Dr. Walter M. W. Splawn, dean of the graduate school of the American University in Washington and formerly president of the University of Texas, is authorized. Dr. Splawn was special counsel to the House committee on interstate and foreign commerce in its investigation of railroad holding companies.

Power and Regulation in State Legislatures

ALABAMA.—Of 45 bills introduced proposing a tax upon or some special sort of regulation for the Alabama Power Company none has yet been enacted into law. Some of these measures indirectly affect other utilities like the telephone and gas companies, but all were intended to apply particularly to the Alabama Power Company. A number of legislators have made attacks on the "power trust." The latest bill is local in its nature, permitting the Mobile City Commission to levy a license tax of 2 per cent on the gross receipts of the power company.

FLORIDA.—A second extra session to consider revenue has met. Among recommendations by a special legislative committee is that $2,000,000 be raised by a kilowatt-hour tax on consumption of electrical energy.

GEORGIA.—Three important bills affecting the power industry of the state have been introduced and referred to committees. One of these is the measure described last week (page 3) to abolish the present Public Service Commission and substitute another. A House bill would impose a tax of $2 on each $100 of gross receipts of electric, gas and communication utilities. The third measure would permit municipalities owning electric or gas plants to issue bonds against them.

ILLINOIS. — The Governor has signed the bill prohibiting mayors or city commissioners from being officials of any public service corporation.

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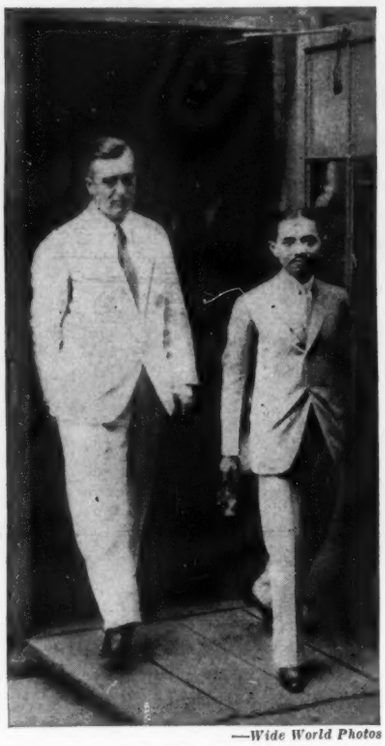
Cosgrove Recommended as Commissioner to Canada

GOVERNOR ROOSEVELT of New York has let it be known that he has communicated with President Hoover urging that the State of New York be accorded representation in the selection of commissioners to be appointed on behalf of the United States to negotiate with Canada a new treaty providing for the development of the Great Lakes and St. Lawrence River for navigation and power purposes. The trustees of the New York State Power Authority unanimously recommended the appointment of Delos M. Cosgrove of Watertown, one of the trustees, as a member of the commission. This recommendation has the support of the Governor and the two New York senators.

From Washington, however, it is reported that the proposed joint commission may never be appointed since the Canadian government is believed to favor the negotiation of the treaty through the regular diplomatic channels.

KING PRAJADHIPOK AT WEST ORANGE



—*Wide World Photos*

Escorted by Charles Edison, the inventor's son, Siam's globe-trotting monarch visits the Edison laboratories.

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Canadian Engineers at Odds Over Beauharnois

WHEN THE COMMITTEE of the Canadian House of Commons inquiring into the Beauharnois power project resumed its activities last week there were sharp differences of opinion between two Dominion government engineers on the merits of different phases of the navigation and power project. K. M. Cameron, chief engineer of the Department of Public Works, declared he was generally in agreement with the plans under which the Beauharnois canal was being built, differing openly from D. W. McLachlan, engineer of the Department of Railways and Canals, who is also chairman of the Canadian section, International Joint Board of Engineers, which investigated the waterway scheme.

Peter White, chief counsel for the parliamentary committee, maintined that the Liberal government had exceeded its authority in granting the Beauharnois company power to divert 40,000 sec.-ft. from the St. Lawrence. For this a special act of Parliament was required, he said.

On Tuesday, July 7, Frank P. Jones of Montreal told the committee that he had made a profit of $780,000 out of a cash investment of $190,000 in the Beauharnois project. He sold out his interest in the syndicate because he had a disagreement with R. O. Sweezey, now president of the Beauharnois Power Corporation, as to the best methods of raising $50,000,000 to finance the building of the canal and power plant. Mr. Jones was then president of the Beauharnois Light, Heat & Power Company, all the shares of which were held by the Beauharnois syndicate.

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Service Charge Upheld by Massachusetts Board

REFUSING TO ADMIT the contention of customers of the Boston Consolidated Gas Company, in which the Mayors of Boston and Somerville joined, that a utility service charge was illegal, this claim being based on an isolated clause in the law construed without regard to other parts of the statute, the Massachusetts Department of Public Utilities, in an order recently issued, says:

Service charges, as allowed by this department, have been based upon the theory that a certain amount of property and service is furnished for the exclusive use of each customer and that in equity and justice to the other consumers the cost of maintaining this property and furnishing this service should be borne by the customer to whose use it is exclusively devoted. . . . The cost of reading the meter and mailing and collecting the bills and the recording of the same, together with the interest, taxes, maintenance and depreciation of the service pipe and the meter, amounts to something over 50 cents a month for the average customer. If the customer uses only a small amount of gas a year, it is obvious that this cost must be largely borne by the other customers using a larger quantity of gas.

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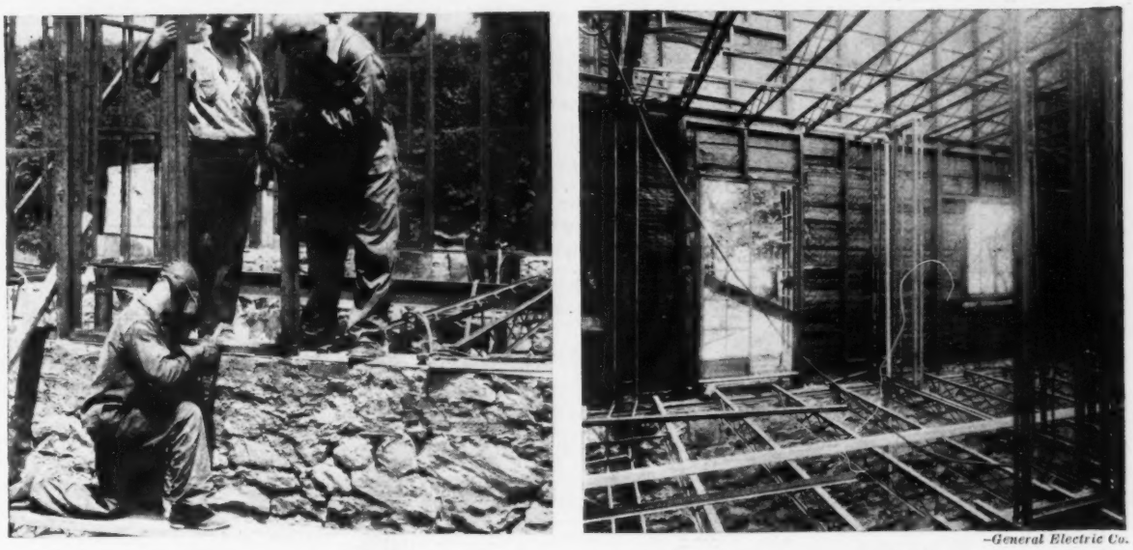
Commission Condemns Penalty for "Slow Pay"

COMPLAINTS AGAINST a penalty charge imposed by the Buffalo General Electric Company where payment of bills was delayed led the New York Public Service Commission last week to approve a memorandum prepared by Commissioner M. C. Burritt directing the company to file new schedules which will meet the complainant's objections. The commission's opinion said:

"It is believed that where bills can be collected with reasonable promptness there should be neither penalty nor discount. This should be left for the company to determine, however. But if the company decides to make a different rate

NOW COMES THE ELECTRICALLY WELDED DWELLING HOUSE



—General Electric Co.

A six-room, two-story brick and steel dwelling constructed by electric arc welding now stands at Larchmont Gardens, N. Y. It is 32 ft. by 26 ft., with basement, and is built on a foundation of stone and concrete. On the left welders are making the foundation joints; on the right the interior is under way.

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for the prompt payment of a bill, the bills should be computed at gross rates and a discount allowed for prompt payment. Such discounts should also be graduated according to the amount of the bill and should not exceed 10 per cent for small bills or 1 per cent for very large bills."

A summary of the company's arguments shows that it believes that the old form of discount rate failed to control delinquent bills which had become unduly large, that it produced too little revenue to pay the cost of collection, and that the penalty form of bill provides a better method chiefly because it permits the company to charge a lower energy rate.

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Michigan's Convention Marks Golden Jubilee

INFORMALLY OBSERVING the golden jubilee of electric light and power service in the Wolverine State, the Michigan Electric Light Association at its annual convention at Mackinac Island, June 29 to July 1, listened to James V. Oxtoby of Detroit as he talked of the early days, including incidents of Henry Ford's employment with the Detroit Edison Company. President D. W. Hayes of Port Huron stressed the fact that employees of the industry in Michigan "serve fair managements and serve a fair public."

The report of the Michigan farm electrification committee, presented by Chairman Floyd D. Avis of Jackson, showed that Michigan now has more than 30,000 electrified farms out of a total of 169,000 and that farm extensions are continuing in 1931 at a rapid rate despite poor business conditions.

The convention devoted one session to a symposium on domestic load building. Charles R. Landrigan, Detroit Edison Company, in a paper on "The Importance, Stability and Characteristics of the Residence Load," said that whereas the average residence consumption in Michigan is 608 kw.-hr. a year as compared with a 1930 national average of 548, there are possibilities of building up this load to at least 6,000 kw.-hr. per year.

Sam Stites, Consumers Power Company, Muskegon, told of new illumination developments. C. L. Bougher of the Michigan Public Service, Michigan Electric Power and Michigan Gas & Electric companies read a paper on sales promotion methods for electric ranges and refrigerators.

At the opening joint session with the Michigan Gas Association, held under the auspices of the Utilities Information Bureau, the speakers were A. C. Marshall, Detroit, the chairman; Clifford E. Paige, president American Gas Association, and Arthur W. Stace, director of the bureau.

Officers for the ensuing year were elected as follows: President, D. E. Karn, Consumers Power Company, Jackson; first vice-president, George W. Baldwin, Edison Sault Electric Company, Sault Ste. Marie; second vice-president, Robert R. Brown, Detroit Edison Company, Mount Clemens; secretary and treasurer, Herbert Silvester, Ann Arbor.

Cleveland Will Have Arc-Welded Steel House

COMPLETE ARC-WELDED steel construction is being used for a residence in the Shaker Heights district of Cleveland, which will cost about $25,000 when completed. It was designed by George Howard Burrows, prominent Cleveland architect and developer of the welded-steel design for residential construction. With one welder and three structural-iron workers approximately four tons of steel was erected during the first day of construction, and it was expected that the entire framework would be completed in two and one-half working days. All steel was cut to size before delivery to the job. All fabrication and erection welding was done on the site, utilizing equipment and electrodes manufactured by the Lincoln Electric Company, Cleveland, for the McKay Building Company, which has the general contract.

The architect states that the house will cost approximately 40 cents per cubic foot and that the use of welded-steel construction will cost only $72 more than the traditional type of wooden structure. Because of its steel frame the house will not sag or shrink and will be fire-resisting beyond most types of dwellings. Other residences of steel-frame construction have been bolted or riveted, and while this resulted in strong construction, the additional cost of fabrication and the large amount of steel required proved too expensive. Mr. Burrows' designs allow the steel to be erected without cutting or punching.

Joint Committee Makes Merchandising Points

ANNOUNCEMENT IS MADE by J. F. Owens, vice-chairman of the Electrical Merchandising Joint Committee, the establishment and purposes of which were described in the ELECTRICAL WORLD for February 21 (page 347), that at a meeting of this body held in Atlantic City recently a statement of "merchandising procedure" was unanimously approved which suggests that electric utility companies take the initiative in bringing about conferences with dealers in their localities. The statement has been transmitted to the executives and commercial managers of about 1,500 member companies. Following the suggestion just alluded to are nine specific recommendations as follows:

1. The distribution of electric appliances should be on the basis of fair and open competition in the interest of the consuming public, the utility, the appliance manufacturer and all merchandising outlets.
2. All electric appliances offered for sale by co-operating agencies should be standard appliances.
3. No appliance or merchandise not directly related to the use of electricity should be sold by electric utilities.
4. In all merchandising activities the retail price of all electric appliances that have received reasonable customer acceptance should be consistent with present-day merchandising practices.
5. There should be no premiums given nor excessive trade-in allowances made in connection with the sale of any such appliance.
6. The presenting to the public of those electric appliances not having received reasonable customer acceptance should be considered as promotional activity and not as merchandising activity.
7. Co-ordinated advertising of approved appliances should be developed by electric utility companies and local dealers, and the electric company should give all reasonable assistance to the dealer in advertising, displays and sales.
8. The deferred-payment feature of merchandising activities should be on an economically sound basis.
9. There should be a segregation of the accounting of the merchandising departments of power companies from their public utility functions, and items of expense incurred in merchandising appliances should be charged to merchandising activities.

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Holding-Company Methods Upheld in Florida Court

DECISION HAS BEEN RENDERED in favor of the Associated Gas & Electric Company and the General Gas & Electric Corporation in a suit brought in the United States District Court for the Southern District of Florida by a minority stockholder of the Florida Public Service Company in which it was alleged that the Associated Gas & Electric and the General Gas & Electric had appropriated for themselves from the revenue of the Florida company large amounts of money without any proper consideration, that they had collected unwarranted and excessive management charges and exorbitant rates of interest on loans, that they had improperly induced holders of the preferred stock of the Florida company to exchange their stock for obligations of the Associated Gas & Electric Company, and that the assets of the Florida company were being dissipated and wasted. The court rendered a decision against the plaintiff on all issues.

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Scattered Happenings in the Electrical Sphere

UNITED STATES

Decision on South Carolina Tax Soon

Extension of time until July 20 for payment of the South Carolina power tax by the Duke Power Company has been granted by the South Carolina Tax Commission in order to allow time for the decision of a three-judge United States court on the complaint of the Carolina Power & Light, Broad River Power and Lexington Water Power companies that the power levy is unconstitutional.

Idaho Tax to Reach Supreme Court

After a hearing before three judges in the United States court at Boise, Idaho, the court issued a temporary injunction against the state authorities to prevent them from collecting the kilowatt-hour tax against the Utah Power & Light Company enacted at the last session of the Idaho Legislature. (ELECTRICAL WORLD, June 27, page 1203.) The court indicated that its final decision will be rendered about September 1. Both sides are preparing to take the case to the United States Supreme Court.

Huntington, Ind., Must Not Compete

Permission has been refused the city of Huntington, Ind., by the Indiana Public Service Commission to enter the commercial field by sales of electrical energy from its municipal light plant. Objections made by the Northern Indiana Power Company, which also serves Huntington, were sustained, the commission holding that public convenience and necessity would not be served by granting the city's application.

Quiz for Los Angeles Power Bureau

Appointment of a special committee of nine well-known citizens to conduct a thorough investigation of operations of the Los Angeles Department of Water and Power in order to put at rest rumors concerning the department, and particularly concerning the Power Bureau, was made recently by Mayor John C. Porter. Announcement of the appointment was made in a message to the City Council and was accepted. Oscar Lawler, attorney, will head the committee.

New Officers for North Central Division

Elected recently as officers of the North Central Electric Association for the ensuing year were Frank Milhollan, Central West Public Service Company, as president; W. H. Burke, Minnesota

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A HUNDRED-YARD DASH IN THE NIGHT

In preparation for the 1932 Olympic games at Los Angeles, elaborate lighting permits the staging of an A.A.U. night track and field meet in the Los Angeles Olympic Stadium.

Power & Light Company, as vice-president, and J. A. Hennessy, Northern States Power Company, as treasurer.

Grand Junction Sticks to Private Service

By a vote of 1,010 to 30, a 20-year electric franchise was granted to the Public Service Company of Colorado at a municipal election in Grand Junction last week. This majority exceeded that by which a proposal to build a municipal electric plant was overwhelmed last April. (ELECTRICAL WORLD, April 18, page 711.) The company will spend $600,000 for expansion, it is said, including small new plants on the Colorado and Gunnison Rivers.

Power Feud at Paris, Tenn., Goes On

Although the United States Circuit Court of Appeals refused to sustain the lower court in finding invalid the contract by which the Paris (Tenn.) city power plant was leased to the Kentucky-Tennessee Light & Power Company, and ordered the case dismissed, the City Council has refused to accept the company's check for $93,237, representing three years' rental, and asserts that the litigation is not over.

Final Cofferdam at Safe Harbor Completed

The last of the three cofferdams which have been built to "unwater" the Susquehanna River, for the construction of the power house and dam of the Safe Harbor Water Power Corporation, which will extend a mile from the Lancaster to the York County bank of the river, has been completed. The substructure of the power house and the major part of the dam are finished. Construction is months ahead of schedule and delivery of power from the first units is expected early next winter. At present 2,300 men are at work.

Consumers Power's New Pontiac Quarters

Possession of a new colonial-style district office building at Pontiac, Mich., has been taken by the Consumers Power Company, which erected it. It is a stone and brick steel-frame structure, 56 ft. by 120 ft., four stories and basement, with provision for three additional floors, and is finished in modern and artistic style.

Postpone Z Canyon Project for One Year

Application of Hugh L. Cooper for a permit authorizing the diversion of the Clark Fork of the Columbia River for the Z Canyon hydro-electric project has been extended for one year by the Supervisor of Hydraulics for the State of Washington. Mr. Cooper stated that he was ready to apply for a Federal Power Commission license and would be able to start construction work within the specified time limit.

Oregon Utilities Buy Industrial Power

The Mountain States Power Company of Oregon has entered into an agreement with the Willamette Valley Lumber Company of Dallas whereby the utility will purchase and utilize 1,375 kw.-hr. of the total of 2,750 kw.-hr. which the milling company is generating in a newly installed steam plant. Other utilities operating in Oregon which are purchasing surplus power developed by milling companies are the West Coast Power Company of Burns, maintaining an interconnecting service with the Edward H. Hines Western White Pine Company, and the Toledo light and power system, which receives the surplus energy generated by the Pacific Spruce Corporation.

San Joaquin's New Power Source

Adding 75,000 kw. to the power resources of the San Joaquin Light & Power Corporation's system, its new substation at Herndon, about 10 miles north of Fresno, Calif., was placed in operation June 30. From this substation a 100-mile, 220-kv. transmission line has been built to Bellota, where it ties in with the Pacific Gas & Electric system. From Bellota the line extends to the Wilson substation, using the steel towers of the present 220-kv. Sacramento-Merced line erected by the Great Western Power Company. This interconnection makes available to the San Joaquin system both hydro and steam-electric power from the San Francisco system.

Municipal Power in Washington State

According to an opinion handed down in Tacoma in a frendly test suit, municipalities in the State of Washington manufacturing electricity can dispose of any "surplus power" outside their corporate limits and should not be restrained from making contracts with other municipalities for buying such surplus. The opinion places legal approval upon a practice which has been carried on by Tacoma and other cities for years, but of which the legality has always been questioned. The issue will be carried to the Supreme Court for final adjudication. Defendants in the action included Seattle, Tacoma, Centralia, Puyallup and Bremerton. The Bremerton Municipal League challenged the right of Bremerton to buy power from Tacoma and complained that until the question had been passed upon Bremerton could not dispose of its municipal utility bonds.

Coming Meetings

Camp Co-operation XI — Association Island, Henderson Harbor, N. Y., July 27-31. Society for Electrical Development, 420 Lexington Ave., New York.

American Institute of Electrical Engineers—Pacific Coast Division, Lake Tahoe, Calif., Aug. 25-28. F. L. Hutchinson, 33 W. 39th St., New York.

Rocky Mountain Division, N.E.L.A. —Stanley Hotel, Estes Park, Colo., Sept. 2-4. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Electrochemical Society — Hotel Utah, Salt Lake City, Sept. 2-5. C. G. Fink, Columbia University, New York.

Pennsylvania Electric Association — Bedford Springs Hotel, Bedford Springs, Pa., Sept. 9-11. H. A. Buch, Telegraph Bldg., Harrisburg, Pa.

Empire State Gas and Electric Association—The Sagamore, Bolton Landing, Lake George, N. Y., Sept. 10-11. C. H. B. Chapin, Grand Central Terminal, New York.

American Welding Society — Copley-Plaza Hotel, Boston, Sept. 21-25. M. M. Kelly, 33 W. 39th St., New York.

New England Division, N.E.L.A.— Poland Springs House, South Poland, Me., Sept. 28-30. Miss O. A. Bursiel, 20 Providence St., Boston.

Great Lakes Division, N.E.L.A.— French Lick Springs Hotel, French Lick, Ind., Oct. 1-3. T. C. Polk, 20 N. Wacker Drive, Chicago.

Illuminating Engineering Society—William Penn Hotel, Pittsburgh, Oct. 13-16. E. H. Hobbie, 29 W. 39th St., New York.

CANADA

Seven Sisters Produces Power

Power is now being produced at the newly established Seven Sisters plant of the Northwestern Power Company, subsidiary of the Winnipeg Electric Company. One unit went into operation on June 3 last, another is almost ready to start, and a third is scheduled for September 1. Each unit has a designed capacity of 18,750 hp., but operating under full head, secured by dropping the tailrace and raising the dam, production can be doubled. The first three units, accordingly, will be able to develop 112,500 hp., approximately one-half of the ultimate designed capacity.

Another Bay of Fundy Proposal

Another scheme for harnessing the Bay of Fundy tides for industrial use is proposed by Frank Parry of Milltown, New Brunswick. The new scheme involves joining the Northumberland Strait and the Bay of Fundy by canals, the difference in height of the two bodies of water being about 47 ft. In addition, the project calls for the construction of three dams as follows: One across the eastern arm of Cumberland Basin, one across Shepody Bay, and one across St. John River at or near the Reversing Falls.

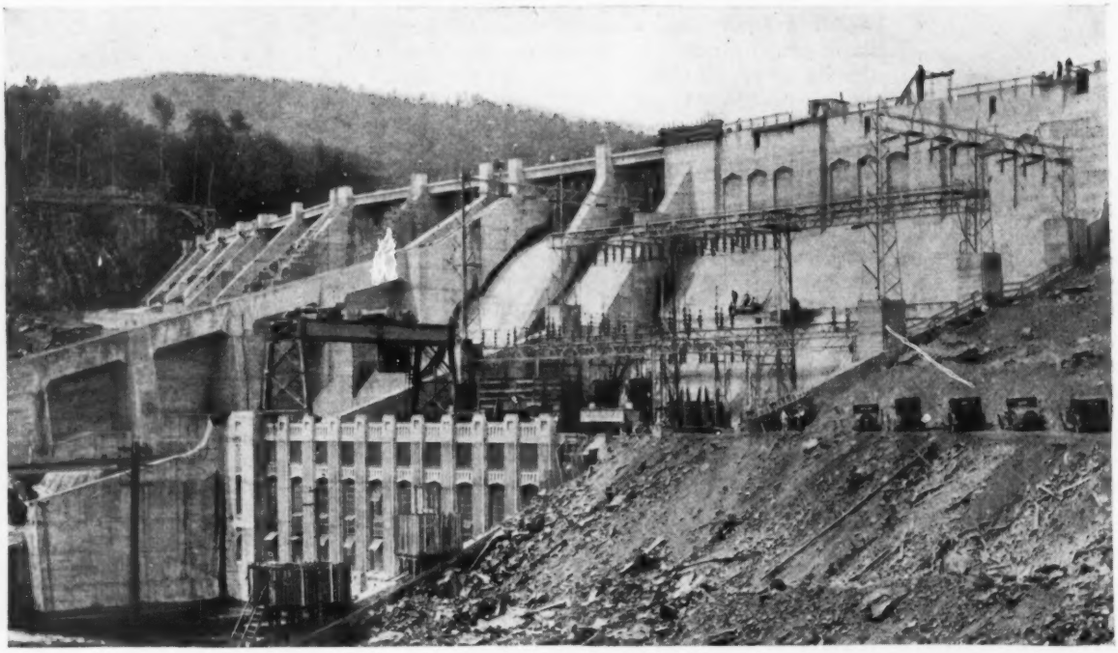
ABROAD

Finnish Electrification Project

To finance the development of the hydro-electric and industrial resources of Finland on a large scale the Sofina electrical group of Belgium has submitted to the government of the country first named a proposal to expend $30,000,000 for this purpose. One feature would involve doubling the power of the Imatra hydro-electric station.

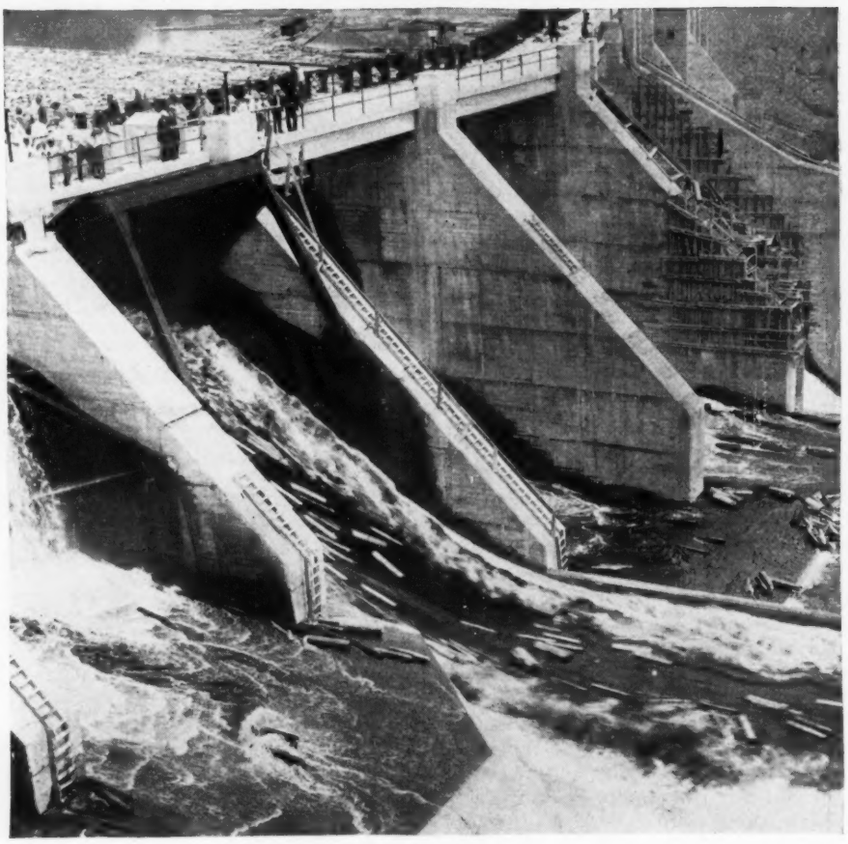
Tasmania, Too, Has a Shannon Plant

On the Shannon River in Tasmania, Australia, a hydro-electric plant, automatically controlled and costing $2,000,000, went into service recently. It was built by the government and increases the potential output of the island's hydro-electric department to 80,000 hp.



The Wyman development of the Central Maine Power Company on the Kennebec River near Bingham adds 80,000 kva. to the electrical resources of the Pine Tree State. Nearly 7,000,000,000 cu.ft. of water can be stored above the 135-ft. dam, which drew heavily upon engineering skill in foundation construction by the caisson method.

Maine's latest hydro in action



Fifty thousand kilowatts of hydro energy being dissipated in a demonstration log drive to clear the forebay. Much surplus capacity at this plant must be wasted in spilled water because of the law prohibiting exportation of such power into other states.

EDITORIALS

L.W.W.MORROW
Editor

Tenney-New England Power merger is significant

PROSPECTIVE merger of the Tenney utility interests near Boston with the New England Power Association group marks another important step in the gradual unification of power companies in the Northeast. So far as can be seen, the day of complete New England service coverage by a single group of properties is still far away, but the trend toward centralization of financial control is unmistakable. With the Boston Edison, Hartford, Lynn, Bangor and New Haven companies leading the independents and the remaining territory pretty thoroughly occupied by six major holding-company groups, nothing like a static condition appears to have been reached, and further alignments may be anticipated in due course. There is good reason to believe that all New England could be served by a single group of properties if necessary and expedient; but able management resides among the independents as well as in the holding organizations and their subsidiaries, and the privilege of serving prosperous territory is not likely to be given away by anybody.

The Tenney-New England Power merger will open a valuable market north of Boston to energy available through interconnection with the New England Power and Edison systems. Engineering developments of interest will be required to achieve these benefits, and in due time considerable new construction will have to be done. Co-ordination of plant operations will make new advances leading toward ultimate service to extended areas at lower over-all costs and consequent public gain. The addition of the Tenney organization, with its three decades and more of experience in handling and developing local properties under centralized management, will further strengthen the New England Power group. The merger is dictated by logical reasons as well as by financial inducements, and full advantage will no doubt be taken of the opportunity to utilize most effectively the united personnel and equipment of the organizations.

Elimination of radio interference is a co-operative task

RADIO interference has been somewhat of a thorn on the stem of a rosy relationship between power and radio interests. Had it not been tactfully handled in local situations, it might well have been a serious and unwarranted handicap to public good will and economical operation of both services. Now the field is to be surveyed by a joint committee of the various groups affected—utilities, electrical manufacturers, radio manufacturers. Listeners to the broadcast programs may confidently trust their interests to this composite group.

The matter has many ramifications, and unless these shall soon be explored and difficulties resolved, it is not unlikely that they will lead to a general application of the current panacea — "There ought to be a law." If any laws would run the risk of muddling a hopeful situation, it would be laws against radio interference framed on a prohibitory concept. The subject is as intricate as inductive co-ordination. A wholesome and almost miraculous example has been set by the co-operative effort to overcome difficulties in the communication sphere without legislative prescription. The solution of the radio interference problem should be allowed to proceed along parallel lines and not be precipitated into false-cure channels by eager and selfish minorities.

Assurance of acceptable reception by radio listeners is not a mere matter of broadcast power, nor of noise levels, nor of filtering devices, nor

of power-system maintenance, nor of defects in household appliances. It embraces all these and more. To accomplish the desired results the answer must start from a set of definitions, a system of units and measuring technique, and then proceed through a code of intergroup ethics to an economic balance of costs. Such a treatment will give the best chance for good radio reception compatible with cost entailed in broadcast power, design of sets, improvement in household appliances, maintenance of distribution systems and corrective measures all along the line. If there "ought to be a law," let it wait until it can be shaped to conform to technical and economic facts and proprieties. Meanwhile the public should have access to such facts and proprieties.

Argument versus declamation

DEFENSE against attack is a primal human instinct, and no one can wonder that leaders in the light and power industry, disconcerted and amazed at the duration and bitterness of political and newspaper assaults upon it, are exhorting its spokesmen to hit back and are pointing the way. Yet caution, prudence and coolness are the fundamentals of successful defense, and if the counseled campaign of retaliation is to consist largely in exchanging epithet for epithet and denunciation for denunciation, it had better not be made. For young partisan orators are sure, like Shylock, to better the instruction, and when they meet distortion by distortion the argument becomes a noise and the judicious are compelled to grieve.

Such time-honored verbal brickbats as "demagogue" and "blatherskite" will not rout the attackers, and the air-cleaving "communist," "bolshevik" and "red" will boomerang through their own ineptitude. Nor can the figmental barons of the "Power Trust" be annihilated by confrontation with the horrific ghosts of Lenin and Karl Marx, the moth-eaten effigy of Robespierre or the raw head and bloody bones of Bela Kun. Like the flowers that bloom in the spring, these theatrical properties have nothing to do with the case.

To zeal declamation may be pardoned, but in putting down mistaken or wrong-headed antagonists a plain tale is to be preferred. Fortunately most of our utility defenders are willing to trust to one. Standing on the fabric of facts, they can afford to admit that, like all sublunary things, the light and power industry is still several degrees this side of perfection; to acknowledge mistakes and even wrongdoing on the part of a few of its leaders; to refrain, whatever the temptation, from imputing insincerity or stupidity to all those who make it an object of attack; to assent cheerfully to the charge that the men who have built it are not philanthropists exclusively but business men also, intent on making two dollars grow legitimately where only one grew before; to ask only that all the truth be educed, that the two sides have an equal hearing, that no company be condemned unheard, that reason, not passion, prevail. Let us have faith in the American voter—an eminently conservative person—and also in the sober second thoughts of political leaders back from the stump and faced by the realities and responsibilities of office.

Solid cable deserves chance to compete with oil-filled

INTRODUCTION of a radical departure in design invariably disturbs the existing economic balance. Oil-filled cables have established a reputation out of their virtues and admirable performance. They have largely pre-empted the field above 66 kv. They have encroached on the province of the non-oil cable. Tests simulating or even more severe than daily load cycles with cables having less than prevailing thicknesses of insulation have shown acceptable performance in Commonwealth Edison Company tests.

The conclusion is inescapable that insulation can be thinner as soon as manufacturers' confidence catches up with test facts and as long as caution on the part of the user jibes with a decreased margin of safety. If oil-filled cables can be substantially smaller, the parallel progress in the non-oil cable should also justify a somewhat thinner wall of insulation. Thus can economic overlap in the vicinity of 66 kv. be resolved more in favor of the non-oil cable.

The performance of oil-filled cable has been remarkably good, and it takes courage to set it aside for cable not incorporating the benefits which oil permeation gives. Nevertheless, the pressure is always toward more cable transmis-

sion in city radials, and especially so with key generating stations outside load areas. Consequently any freedom of play of the physical and economic factors which fix cable diameters, cable prices and costs of installation will operate to give power delivery the chance it needs to match the savings made in recent years in power generation.

Oil-filled cable demands elaborate measures for confinement of oil to specific cable sections as well as reservoirs and oil piping. For the moment this oil system is an unavertable adjunct of high-voltage cable. However, the quicker it is viewed as a dispensable excrescence and high-voltage cables are made as self-sufficient as those of lower voltage, the quicker will all cables narrow the wide cost disparity between them and open wire construction. Research knowledge about insulation and grasp of the elements which have made cable performance a matter of uncertainty are both nearing the point where more confidence in materials, fabrication and handling will justify less generosity in providing tolerances to cover doubts.

British grid progresses

PROGRESS of the British grid system has been rapid, according to the recent report of the Electricity Commissioners for the year ended March 31, 1930. During the year the kilowatt-hour production was 10,400,000,000, as compared with 9,323,000,000 in the previous year, and the total added generating capacity was 798,455 kw., including six important new generating stations.

Increased business came largely by reason of the domestic load, but the per capita consumption is still only 191 kw.-hr. per year. High domestic rates, lack of promotional rates and a rather chaotic distribution and sales system handicap rapid development of domestic business, but steady improvement is recorded, and in Great Britain as in the United States the attention of the electrical industry has as its center the completely electrified home.

The Electricity Commissioners are completing their lines and stations and are getting proper co-ordination between local authorities and themselves. In Great Britain as elsewhere no greater benefit could be conceived than an ample, economical and universal supply of electricity, and this is coming into being despite tradition, legal handicaps and stagnant business. Great credit must be given the able managers and engineers who are responsible for the progress of the nation-wide grid that will in time bring an electrical revolution across the sea.

Slowness of the electron tube

DESPITE the fact that there is no other electrical apparatus that performs with such time-shattering abruptness as does the electron tube, the tube has none the less a quality of slowness. This lethargy does not reside in the device itself but in the spread of common understanding of the uses to which it may be applied; for it is true that the tube is entering only slowly those fields of electrical control to which it is so admirably adapted.

The electron tube has as yet been accorded no place in the philosophy of the control salesman who roams about through industry seeking locations and duties in and to which the product he sells can be applied. It is the function of the salesman to show the prospective user where and how specific devices may be used. The customer probably has a little general knowledge of the possibilities of the electron tube, but to him it is still something in development, not yet far enough along to be included among his practical ideas on electrical matters. It is the duty of the salesman, therefore, to acquaint the customer with specific possibilities of the tube in the customer's specific applications. But the salesman does not do this, because primarily he has little if any conception himself of electronic engineering and his factory executives have never made him conscious of that lack in his selling equipment.

The reason is simple. Almost every advance in the art of electrical control in industry has had its origin in the field, not in the plant of the manufacturer. It is as much the salesman's job to perceive the problems of his field and present them to his factory for solution as it is for him to sell the products of the factory. The salesmen have not been carrying back to their factories suggestions for uses of electron tubes, and naturally the factories do not produce equipment embodying those suggestions. From this it appears that it is up to the wide-awake control salesman to take a course in electronics.

Oil-Blast Phenomena in Circuit Breakers*

By JOHN D. HILLIARD
Consulting Engineer
Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Functioning of prevailing types utilizing oil-blast action reduced to elementary principles.

Double break and hollow rod aid curtailment of ionization.

THERE are several possible types of the so-called blast oil breakers, each having its own peculiar operating feature. Thus there are:

(a) Explosion chamber breaker with solid contact rod.

(b) Explosion chamber breaker with tubular contact rod.

(c) Oil-blast explosion chamber breaker with solid contact rod.

(d) Oil-blast explosion chamber breaker with tubular contact rod.

(e) Top vented explosion chamber breaker, with solid rod, although hollow rod may be used.

(f) Deion oil breaker and other blast breakers with special operating features.

The accompanying figures show typical elementary chambers with a movable contact rod M in three positions, X, Y, Z, in each type of breaker, and, to simplify matters, all consideration of leads, chamber insulation, stationary contacts, operating mechanism, tank and oil, etc., are eliminated, the chamber merely being conceived as immersed in oil in the oil tank and having a small "bleed" hole in its top to permit the escape of trapped gas after interruption, with a resulting inflow of oil which fills the chamber preparatory for the next interruption.

In Fig. 1 is shown the standard explosion chamber breaker with a solid contact rod, such as was made fully 25 years ago and has been in large production since that time. In this breaker the chamber is usually of metal and is made to resist high internal stresses. There is a proper clearance between rod M and throat opening to provide for the escape of oil and gas until the rod clears the throat, and this acts as a safety valve and prevents the blowing up of the chamber.

In the Y sketch the gas in the chamber is under high pressure and the oil carried along by the gas, due to gravity flow, gas-oil friction and pressure gradient, is atomized as it is projected into the high-velocity gas stream, near the approach to and in the throat. The atomized oil acts as a jet condenser to cool the issuing gas in the throat and beyond; moreover, the gas stream is projected at high velocity into the body of cold oil below the chamber.

It will be understood that prior to the gas being given high velocity near to and in the throat the arc has acted as in a plain break breaker under high pressure, and just as the plain break arc will show widely varying arc lengths at interruption under as near identical conditions as they can be made, so the arc lengths in the case of chamber interruption vary widely in length, and many times the circuit is interrupted before the end of the rod has reached the throat opening. In the case of severe conditions for interruption the arc will nearly always be drawn out of the chamber, but the total arc length in such case is always much less than would have been the case if a plain break breaker had been used.

In the Z sketch any ionized gas originating in the "white hot spot" on the end of contact rod M is blown away through the throat instead of ascending to the main gas body to maintain conductivity, as was the case in the plain break breaker. From the preceding explanation it would appear that the circuit interruption is brought about by combined cooling and turbulence of the gas carrying condensed oil vapor, atomized oil and solid carbon molecules, the presence of these solid particles very greatly accelerating the neutralization of the ions above the rate obtainable in pure gas alone.

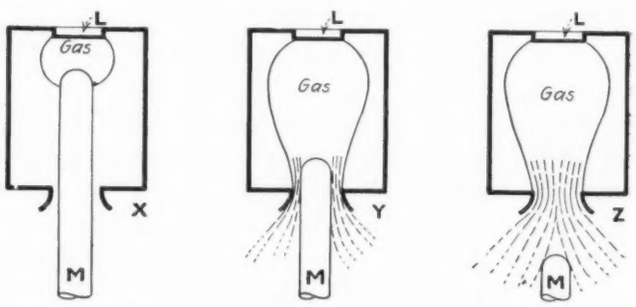


Fig. 1—Explosion chamber breaker

X. Contacts separated, gas formed, some oil ejected.
Y. Contact rod M near throat, oil has been ejected, gas now escaping around contact rod.
Z. Rod out of chamber, gas cooled, oil atomized with full vent in throat.

*See also paper in ELECTRICAL WORLD *of May 2, 1931, pages 809-811.*

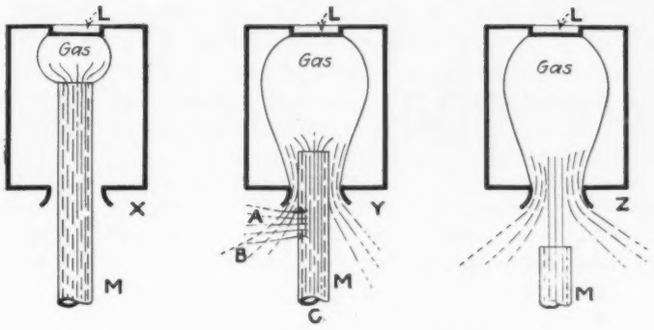


Fig. 2—Effect of tube replacing rod

X. Small gas volume formed, oil has moved down the tube.
Y. Tube end approaching throat, gas ejected through and around rod and out of side opening at *B*.
Z. Same as Fig. 1 (Z).

It is difficult for the writer to see how the conception that circuit interruption always took place within the chamber originated, as the break distance provided external to the chamber should plainly indicate to all the sometime drawing of the arc out of the chamber before interruption.

Whether this structural embodiment actually interposes an impervious layer of oil between electrodes so as to cause interruption is a debatable question, and rather immaterial to the user, but it is hard to see theoretically how the oil can be consistently so interposed, and one must conclude that interruption is brought about largely by deïonization due to the severe blast in the arc stream at the throat caused by the expansion of the gas under compression in the chamber at and near zero current value.

Contact acceleration due to the chamber pressure acting upon the contact rods operating as pistons is another feature affecting the interrupting efficiency. The total quantity of gas generated varies with the arcing duration, and anything which decreases this quantity of gas also decreases the pressure within the oil tank, but it may or may not decrease what is of perhaps greater importance, namely, the mechanically reactive stress applied to the bushing assembly, but more on this point later.

Tube in place of solid rod

The only difference between Fig. 1 and Fig. 2 is that a tube is used as the moving contact member instead of a solid rod.

One of the factors affecting the efficiency of a breaker is the speed at which the oil and gas can be evacuated from a chamber equipped with a given size throat. It will be realized that the speed of the gas and oil jet issuing from the tube or throat with a given chamber pressure varies with the mass of the moving material within the tube or in the throat, including, of course, the accompanying friction loss, and anything we can do to reduce this mass increases the speed of evacuation and the breaker efficiency, and this is the sole reason for the side opening.

In the case of sketch Y, Fig. 2, there is no chance for ionized gas from the "white hot spot" on the end of electrode to ascend to the gas volume in the chamber, and thus maintain an ionized conducting path, because the high-speed gas and oil stream flowing over the edge of the tube promptly carries it out of the chamber. It will be found, as a general thing, that this tube contact construction is more efficient than the solid rod in most breakers, but there are exceptions to the rule.

The use of a tubular electrode is not new, as it was patented by the writer so long ago that the patents expired several years ago.

It is probable that this Fig. 2 breaker construction usually interrupts by deïonization caused by the gas and oil blast just as it did in Fig. 1, but there is a greater chance for an oil film formation causing interruption than in Fig. 1.

In explosion chamber breakers interrupting large currents the rate of gas generation is very high, which means that a large clearance between the rod and throat is necessary if the chamber pressure is to be kept within reason; this indicates that a large diameter throat must be used, but, as was shown by Prof. J. J. Thompson in 1906 and by Dr. Slepian in 1928, and known generally by those engaged in the commercial work from about 1920, a small opening gives a more efficient interruption.

In breaker design it is a case of balancing the chamber pressure against throat and rod diameters so as to give efficient interruption and not endanger the safety of the chamber.

This large throat difficulty was surmounted by the writer by the use of the top-vented explosion chamber.

Top-vented explosion chamber

In this construction the major part of the gas generated in the chamber is spilled through openings in the top of the chamber, as shown in Fig. 3.

In this embodiment the throat is kept small and efficient, the chamber pressure is limited to that necessary to give the desired electrode acceleration and the small throat area greatly shortens the arc, and within its applied use the spilled gas does no harm.

In sketch Z, Fig. 3, there is shown a blast of atomized oil and gas issuing from the throat; thus there is being deïonized at the throat a relatively small part of the total gas volume generated in the chamber and escaping in the path of the current flow.

It is this relatively small flow of gas which must main-

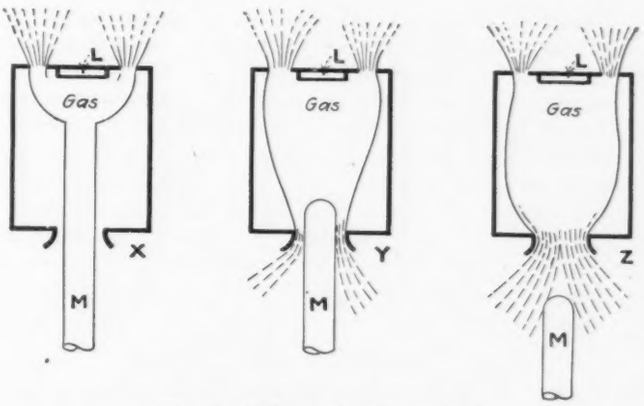


Fig. 3—Effect of top venting

X. Gas escapes through top opening, reduci.. pressure.
Y. Gas escaping through top vents and around throat opening.
Z. Small portion of gas, atomized and deïonized, in path of current flow.

tain conductivity in the breaker if it is to be maintained, because that spilled at the top is not thrown against or in the path of any conductors maintained at a difference of potential, and this gas in its passage through the top chamber openings and oil body above the chamber is made relatively non-conducting and reaches the air space above the oil as an electrically inert gas and is therefore not capable of causing a grounding of the circuit. It is evident that a tubular contact member could be used in place of the solid rod shown, in which case it would act as in Fig. 2.

Because of the top venting the same small throat

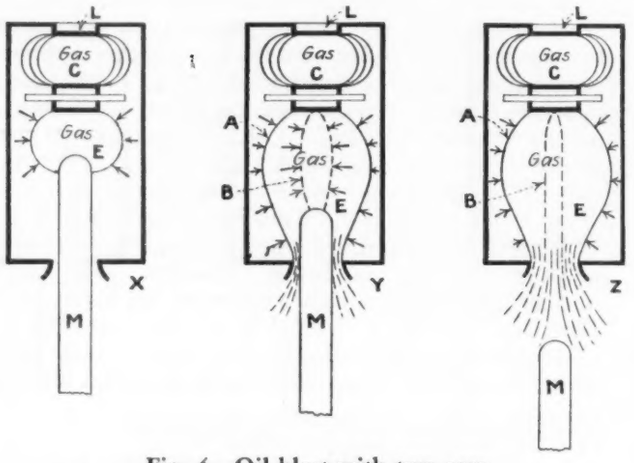


Fig. 4—Oil blast with two arcs

X. Arcing in gas spaces *C* and *E* between two sets of contact. External pressure on gas volume *E*.
Y. Gas and oil being ejected.
Z. Blast extinguishing the arc.

diameter can be used with either the solid rod or tube, as a large clearance is not needed in order to hold down the chamber pressure.

It is debatable theoretically whether the solid rod or tube would be more efficient in this embodiment. The solid rod could have the smaller diameter, and therefore the smaller throat with a given clearance, with a resulting increasing efficiency. On the other hand, the gas from the "white hot spot" would more readily be swept down the tube and out of the way, and thus not be able to affect the degree of ionization of the gas in the arc path.

Both contacts are very efficient and in my opinion it will matter little which is used.

The top-vented embodiment offers more chance for an oil film interposition than those previously cited because of the smaller quantity of oil ejected before interruption, leaving a relatively large body of oil available to cover the rod end. This type of breaker also permits the use of a smaller chamber diameter for a given interruption, with a resulting smaller tank diameter and length; in short, it is a more efficient breaker within its sphere of operation.

The oil-blast breaker of 1921

The oil-blast breaker was invented by the writer in 1921. It differs from previous blast types of breakers in that there are two independent arcs drawn in each chamber, the arc first drawn serving to generate gas and supply a pressure to drive oil upon the second arc where interruption is to be effected.

In Fig. 4 this breaker is shown with a solid contact rod M. In operation the contacts forming gas volume *C* are separated to a definite distance before the contacts forming gas volume *E* separate, which latter contacts continue to increase in separation until the circuit is interrupted.

The gas volume *C* is trapped in the chamber and kept separate from gas *E*. Gas *C* cannot escape except through the small "bleed" hole provided to effect refilling of the chamber with oil after an interruption preparatory to the next interrupting operation.

Successive half cycles of arc at a given current flow add a definite amount of gas to the volume *C* and provide for a continuously increasing pressure available to act upon gas volume *E*.

The pressure in gas volume *C* (Fig. 4) will act to affect the volume of gas in *E*, and as soon as the rate of gas generation in *E* is less than the rate of escape of *E* to the outside of the chamber the pressure from *C* will close in the oil walls surrounding gas volume *E*.

The closing in action does not wait for the zero value of current wave to arrive, but commences, as stated above, as soon as pressure in *E* is less than pressure in *C*. The closing in of the oil is therefore not a question of a few

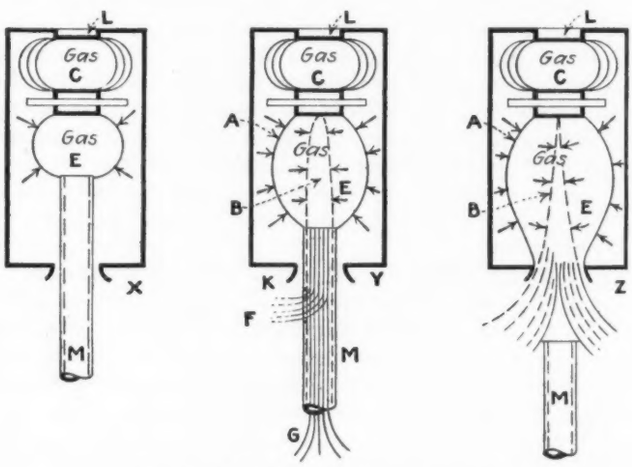


Fig. 5—Oil blast with hollow rod

milliseconds, but may be of the nature of the time represented by perhaps one-quarter of a half cycle.

The rate of exhaust of the gas from the chamber is extremely high because of the small mass of the gas (hydrogen) and the high pressure in the chamber.

The result of the preceding action is the closing in of the oil on the gas volume *E* until there is only an extremely small gas core *B* in the original gas volume *E*, which in itself means rapid deionization, followed by the eventual filling in with oil of the space previously occupied by the gas at or near the zero of a current wave.

It should be remembered that as we approach the time of zero current flow the oil inflow has acquired considerable velocity because of the time available for its acceleration as represented by the assumed quarter of a half cycle of wave.

If the arcs restrike, the pressure generated in *E*, because of its greater arc length, drives back the oil and recompresses the gas in *C*, where gas is also being simultaneously generated; this *C* gas again expands and

acts on E as soon as the pressure in E is sufficiently reduced by gas outflow and rate of generation.

We have, therefore, alternate expansion and contraction in gas volumes C and E, with a resulting surging of the oil back and forth until the circuit is interrupted.

It will be noted that the above-described action is different from that in the standard explosion chamber breaker, where there is alternate generation and exhaustion of the gas but no appreciable closing in action of the surrounding oil body to effect a decrease in the volume of space occupied by the gas.

In Fig. 5 is shown the same breaker, except that a hollow contact rod is used, preferably slotted to allow greater acceleration of the material evacuated from the chamber, thus effecting more prompt interruption of the circuit.

For easy interrupting conditions the use of the tubular contact member should assure interruption while the member is still in the throat, but for more severe conditions I would expect the member M to be entirely withdrawn from the chamber at the instant of interruption.

In the construction as outlined it is quite probable that there is the actual insertion of a plug of oil which raises the dielectric strength in the arc path so as to assure interruption, but whether or not it in all cases actually does this is immaterial, as it is certain that the back-and-forth pulsation of the chamber oil acts to increase the dielectric strength of the material in the arc path and thus brings about interruption, which is the end in view. In short, methods and means are of fully as great importance as theories, which may or may not be correct.

▼

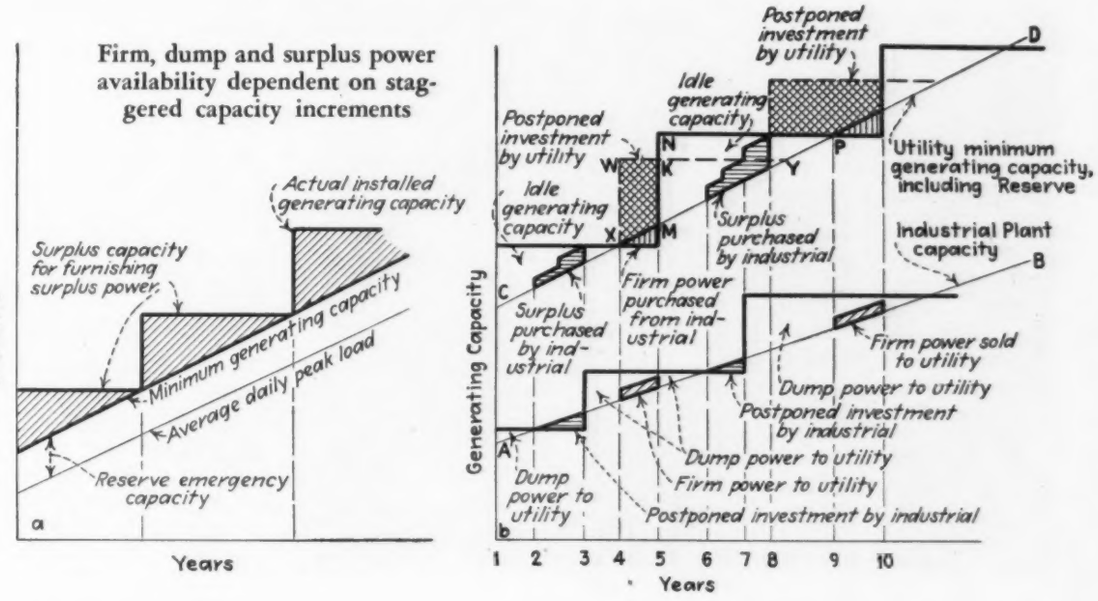
Staggered Expansion Makes Power Interchange Economical

Interchange of power between utilities and industrial plants on a sound economic basis of advantage to both parties is greatly facilitated by a full recognition of the factors which enter to delay investment by either party and make surplus capacities controllable. W. B. Skinkle of the United States Steel Corporation, Pittsburgh, at a recent joint meeting of the A.I.E.E. and Association of Iron and Steel Electrical Engineers, called attention to these factors and enumerated five principal situations which lead to the interchange negotiations:

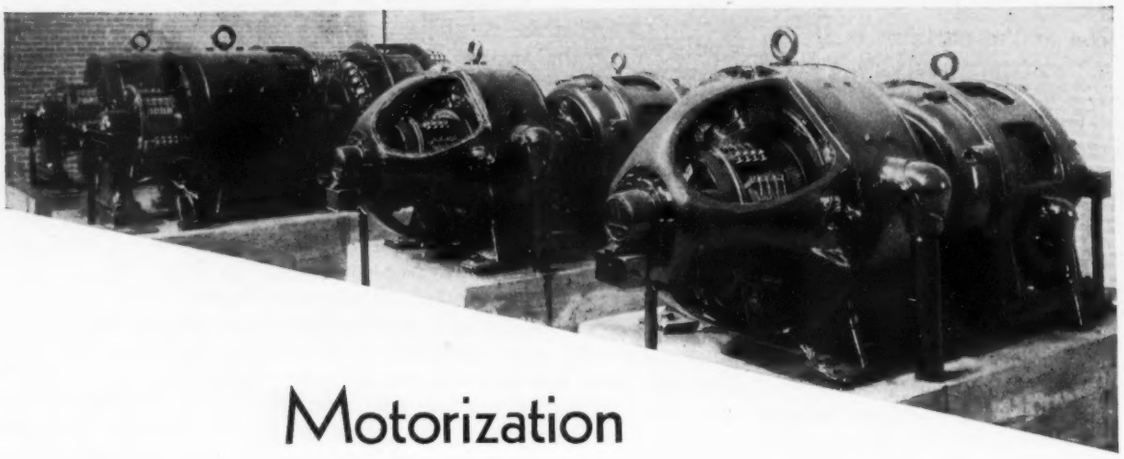
1. Firm power in either direction at any time.
2. Surplus available due to excess capacity in plant of either party.
3. Dump power on purchaser's peak.
4. Dump power off purchaser's peak.
5. Emergency power from either to the other.

In ascertaining the periods when such types of power are available one must have regard for the correlation of the increments of capacity added to the two systems as their respective demands grow. Taking the utility alone for a moment, the increments occur at intervals and in steps which establish a considerable kilowatt-year burden of carrying charges on surplus capacity. Any postponement of the assumption of this burden and opportunity to devote the existing surplus to revenue production or even to purchase firm power from an industrial are justification for a receptive attitude toward interchange of energy with the industrial.

Considering an industrial plant of some magnitude, such correlation offers attractive possibilities in all these respects. Its stepped graph of capacity increases to meet load growth will be comparable to that of the utility, although the rate of increase may be substantially different. A correlation of these two expansions in such a way that they are definitely staggered discloses the potentiality which the developments hold for common benefits to both parties. It is very evident that any contractual relationship must possess a high degree of flexibility and minimized restraint if these potential economic advantages are not to be inhibited by rigidity in the contract. The point is not so much that the expanded plants can be controlled in accordance with a predetermined schedule of added capacities as that proper observance of the possibilities contained in proper correlation requires a contract that gives freedom of action to those who are delegated to execute it with maximum benefit.



(a) Normal capacity growth of utility or industrial alone. (b) Correlated growth of utility and industrial plants. Availability of firm power from industrial plant in interval 4, 5 permits postponement of utility investment for increased capacity and saves carrying charge proportional to area XWKM. Similar saving accrues to industrial in interval 6, 7.



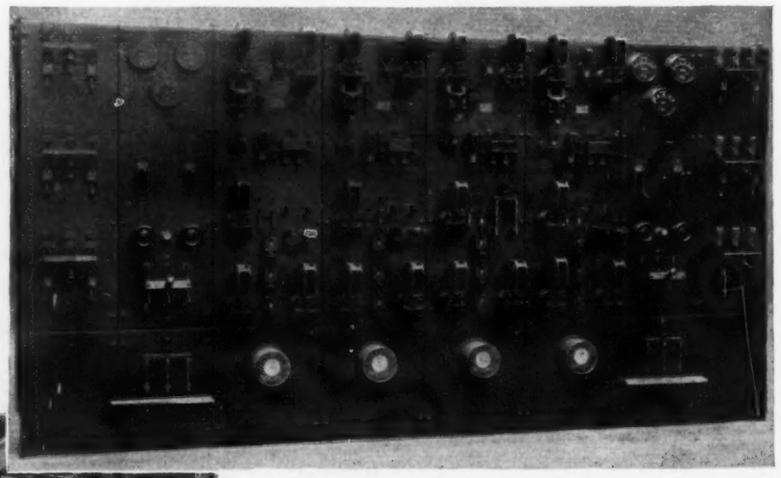
Variable-frequency motor-generator sets supplying power to run-out table roll motors

Motorization of Run-Out Tables

By STRICKLAND KNEASS
Chief Engineer A. M. Byers Company

THE run-out table rollers on the 14-in.-to-9-in. skelp mill of the A. M. Byers Company are driven by 80 motors rated $\frac{1}{3}/\frac{3}{4}$ hp., 117/318 volts, 13.3/36.1 cycles, 256/700 r.p.m. The motors are totally inclosed and have a tapered roll mounted directly on the shaft extension on both sides. All motors are provided with Timken roller bearings, lubricated from the end of the roller through a hole in the shaft.

For supplying these motors there are provided two motor-generator sets, each consisting of a 30/90-kva., 117/318-volt, three-phase, 13.3/36.1-cycle, 399/1,080-r.p.m. alternating-current generator driven by a 40/75-hp. adjustable speed direct-current motor. One set supplies all roll motors, the other set being kept as a spare.



Control panels for control of four variable-frequency motor-generator sets furnishing power to run-out table roll motors

Table motors on the 20-in.-to-16-in. skelp mill showing the breakers mounted below each motor

The run-out table rollers on the 20-in.-to-16-in. skelp mill are driven by 65 motors rated $\frac{3}{8}/\frac{3}{4}$ hp., 110/220 volts, 10/20 cycles, 144/288 r.p.m. The rollers on this table were too long to be mounted on the motor shaft so an overhung construction was used in which the rotor of the motor is pressed on the roller shaft extension and the stator with dummy end bell is bolted to the roll bearing housing. Two motor-generator sets are provided for this table, one being used as a spare. Each

set consists of a 60/120-kva., 110/220-volt, three-phase, 40/20-cycle, 300/600-r.p.m. alternating-current generator driven by a 50/90-hp. adjustable-speed direct-current motor.

The control for these tables is designed to take care of any possible trouble which might occur without putting the table out of commission. A motor control panel is provided for each motor-generator set. In case of trouble to one set or control, a change-over switch is thrown connecting the generator of the spare set to the bus and operation is continued. In addition to the motor and generator panels, a feeder panel is provided for each table mounting three three-pole carbon circuit breakers. The table motors are arranged in three circuits, every third motor being in one circuit and fed through one of the circuit breakers on the feeder panel. In case trouble should occur to any feeder, its circuit breaker opens, but two-thirds of the roll motors are still in service.

An unusual feature is the use of small three-pole inclosed circuit breakers with overload trip on each motor. In the past it has been general practice to use a fuse block or thermal cutout for each motor. This has the disadvantage that if one fuse or cutout blows the motor will continue running on single phase. With these three-pole breakers the motor is entirely removed from the line. There are no thermal elements to renew, the breaker being reset by moving the handle to the extreme "off" position and then to the "on " position. The equipment, motors and motor-generators were supplied by the Westinghouse Electric & Manufacturing Company.

On this installation the advantages of individual drive were so well recognized that group drive was not considered. Among the advantages of individual drive are the following:

1. *Greater reliability.*—With group drive, the failure of the motor or any gear or shaft will put the table out of operation. With individual drive the failure of a driving motor affects only one roll. Several motors can fail without having any effect, except somewhat increasing the load on the remaining motors.

2. *Greater flexibility.* — Individual drive permits cutting out of service rollers found unnecessary on certain schedules. If any change in the table must be made, it is an easy matter to add or remove a few rollers.

3. *Reduce maintenance.*—Experience has shown that individual roll motors give very little trouble and that maintenance costs are very low. There are only two bearings on each roller unit and there are no shafts or gears to keep lubricated.

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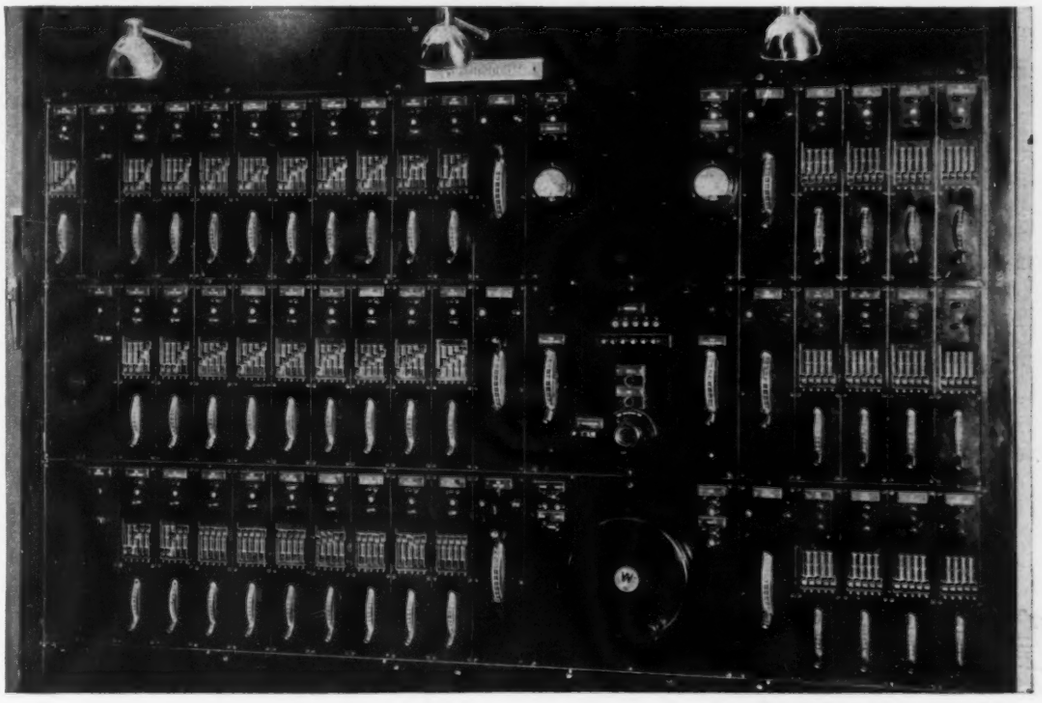
Los Angeles Theater Adopts Preset Proportional Dimming

Flexibility of lighting control is obtained by the thermionic control incorporated in the switchboard recently installed in the new Los Angeles Theater, Los Angeles, Calif., and manufactured by the Westinghouse Electric & Manufacturing Company. By means of this control the lighting for five scenes is set up in advance, a smooth change of light from scene to scene at a controlled rate is obtained and proportional dimming is accomplished by the use of a master switch. Proportional dimming means that two or more circuits at different settings of intensity maintain their same relative brilliance while being dimmed.

The control apparatus required for each circuit consists essentially of a dimming reactor, thermionic tubes and a system of small potentiometers. The alternating-current coils of the reactor are connected in series with the lamp load, whose current is directly dependent on the direct-current saturation current of the reactor, which current is supplied by the thermionic tubes. These tubes are controlled by the potentiometers on a steel panel switchboard. The thermionic tubes and the dimming reactors are mounted in what is called the "reactor rack."



Potentiometers on steel panelboard control theater lights

A Picture or 1,000 Words?

By HARRY REID
Chairman Public Relations Section, N.E.L.A.

A vivid dramatic cartoon appeared in a newspaper* recently. In the center was the sinister figure of an octopus. His tentacles stretched out in all directions. In each tentacle was wrapped the flabby figure of a man in top hat and morning coat. Across the octopus was written the worlds "Holding Company." Each of the little men was labeled "Dummy Power Company." It is a vivid image, which imprints itself vividly in your mind.

Here is an unfair and misleading charge against our industry. It is an example of the highly colored falsehoods which are constantly being placed before the public by certain editors and orators.

How are we going to answer such attacks?

Take the cartoon I have cited, for example. In answering it, we are tempted to tell the public how holding companies have improved the credit of their subsidiaries; lowered rates through reduced financing costs; provided skilled engineers, accountants and operators, effecting lower rates and improved service through increased efficiency and brought about interconnection of operating companies, thereby reducing operating costs.

But if we say these things, as I have just said them, the image of the octopus will still remain in the minds of millions of people. That cartoon was vivid, dramatic, and easy to understand. But the words I have been using are for the most part abstract and technical.

They are taken from the specialized legal, engineering and financial language of our business. They are words which should be used in addressing groups of people trained in business and economics. But we are trying to get our message through to 25,000,000 people, many of whom have little or no business experience.

Your own experience will show you what we are up against. If you are an engineer, what is your reaction to a long legal document, filled with its involved "whereases" and "aforesaids"? And those of you who are lawyers, what is your reaction to an engineering report with all its talk of kilovolt-amperes and phase displacement? Confusion and bewilderment, in either case.

Yet you are trained and experienced in this business. Now think of the average newspaper reader, who is also our average household customer. It is easy to see how bewildering he must find our technical language as a whole, where the words of the engineer, the lawyer, the accountant and the rate expert are all piled on top of each other. The average housewife has a vocabulary of only 2,500 words. Do you suppose that this vocabulary includes such words as "rate base," "increment cost," "service charge," "reproduction cost," "fair return," or even, for that matter, "kilowatt-hour"?

We know the meanings of these words because we are paid to. It is our job. But what of the other men and women? They have their jobs to think about. When they talk they are going to talk about their work, their hobbies, their homes, and their families. They are not going to waste any more time talking about us than they can possibly help.

What is the result? Look at our average customer on his front porch some night after supper. He is turning through the pages of his evening paper. On one page he sees a cartoon attacking the electric industry. It is vivid, dramatic, interesting. It shows a fat man with a dollar sign on his vest, sitting on top of a little man, called the Common People. He quickly grasps the idea, for he can take it in at a glance. And it sticks in his mind.

Now suppose that he turns the page and finds an article defending the industry. He glances at it, and if it interests him, he will read it. But if it does not interest him, if it is full of dry statistics and long words which he does not understand, what does he do? Quite naturally he turns the page to see what the Gumps are up to that evening, or who is leading in the National League.

"One picture is better than a thousand words," some one said many years ago. This remark is as true today as it ever was. And it has special significance to those of us who are engaged in public relations work.

The human mind responds to pictures, whether they are drawn with lines or painted with words. Here is a fact which we must recognize, a fact rooted deep in human nature. Throughout the year ahead we must constantly ask ourselves this question: Are we speaking in such a way as to make ourselves understood?

We must speak the language of our customers. We must translate our technical terms into language which they will understand. It is not enough, for example, to publish an advertisement stating that electricity is cheap because "the average household rate has been reduced 31 per cent between 1913 and 1930 and now stands at 5.95 cents per kilowatt-hour." Such a statement is lifeless and unreal. But translate it into terms from the customers' own experience. Speak of electricity in terms of a stick of gum, a package of cigarettes, or an ice cream soda. Show how much work a given appliance will do for the cost of any one of these everyday articles. Do this, as certain companies have done, and your customers will quickly realize the true cheapness of electricity. You are speaking to them in pictures, in images, and they will understand you.

So in every message to your customers. Speak of taxes as a percentage of gross revenues, and they will think very little about it. But translate taxes in terms of new schools and new roads, and they will appreciate at once the constructive part you are playing as a citizen. Speak of a service charge as a legal return on the capital investment needed to serve your customer, and he will go right on grumbling. But translate it in terms of the lease which he must sign for his house, and the rent which he pays, and he is much more likely to understand the justness of the charge.

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Co-operative Industrial Research

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By JOHN B. WHITEHEAD
Dean School of Engineering,
Johns Hopkins University

—Support for research very small.
—Industrial research needs scientific background.
—New developments coming from scientific researches chiefly.
—Business in mass should support and benefit from research.

RESEARCH is the channel through which we have the steady advance of knowledge, the increase in the conveniences, comforts and economies of living and in the consequent expansion of industry and business, the ultimate agencies through which the results of research are made available to mankind. Scientific research on all accounts is well worth while. The realization of this is reflected in the remarkable increase in the number and type of agencies engaged in research. Originally confined chiefly to university laboratories, we now find independent foundations whose only purpose is the encouragement of research, national societies and governmental agencies supporting and prosecuting research, and particularly, as the chief topic of this brief article, an increasing number of co-operatively supported research undertakings.

The few years since the opening of the present century have been noteworthy for the increasing realization by business and industry of the importance of research to their growth, their expansion and their profits. Business and industry are the normal channels through which the results of research are put into concrete form and its benefits made available to society. The results are a dual stream of profits, shared in by both public and industry. The public enjoys increased comforts, conveniences and lower prices. Through increased business based on the continuous offerings of the results of research, industry and business appear as the dispensing agents with a steady and very tangible money return from quantity production and sales. Moreover, the greater the activity in research, the more numerous the benefits and the bigger the profits. Research, then, is very worth while.

From the foregoing it would seem as though there should be no hesitation nor stint on the part of capital in investing in research as an enterprise big with promise of successful returns. Yet when we turn to the figures giving the money actually spent in research undertakings, we find the figure to be ridiculously small and disproportionate to the enormous returns which are now being enjoyed as the result of foregoing research. University laboratories, the cradles and training centers for research, rarely have adequate support. Governmental laboratories notoriously have niggardly appropriations. Research foundations cannot encourage more than a fraction of the opportunities they see. A few industrial laboratories only seem to have all they need, but these may rather serve as examples of the rewards and business success in sight for those who will do likewise.

What, then, is the answer to this situation, and why is not greater support of research forthcoming? The ultimate importance of research to all progress will probably be granted by all industrial executives. It is obvious that business and industry, deriving therefrom the greatest financial return, should be the principal contributors to the support and expansion of research activity. Yet it is equally obvious that the contribution of industry and business in general to the support of research is ridiculously small, if, as it should be, research is to be considered a normal and important part of industrial activity.

One very important factor which doubtless contributes to the apparent hesitation of industry to inaugurate research as a major activity is the uncertainty of successful outcome and of results of commercial value. In industry money expended must show a reasonably clear and quick

return. It is a well-known fact, however, that in industrial enterprise large sums of money have often been expended on experiment and development which have yielded little or no practical results, and which therefore must thus stand as a loss. Research, from its very exploratory character, can never give absolute promise of useful outcome, and unless carefully conceived and guided it may often come to nothing. Moreover, the word research has been terribly abused, and it frequently covers a blind program of uninformed cut-and-try method and aimless searching for something new or better, which is doomed to failure in advance. The scepticism of many an executive as to the value of industrial research is based on costly experience of this kind.

Divisions of research activities

On the other hand, there is abundant evidence that in the hands of a competent and well-informed scientific staff the most promising lines of investigation may be chosen, profitless experiment soon recognized and the full benefit of intelligent research realized. The legitimate field of scientific research may be roughly subdivided as follows: (a) The discovery of new facts, (b) the experimental study of these facts and the development of new theories and new knowledge, (c) the application of such new facts and knowledge to increased economies, conveniences and comforts for man. In the two first of these fields we find the so-called pure research worker, the scientist who is interested in the pursuit of knowledge for its own sake. This type of worker is found in the university and those other laboratories founded by independent foundations for the prosecution of pure research. To the worker in this field it makes little or no difference whether or not the results of research may have practical application. In many cases they do, but this is only incidental, and the concern and reward of this worker consists only in the answer to the question whether or not an addition has been made to the sum of human knowledge. The third division is, however, the very practical field in which industrial research has its great opportunity, for here the discoveries and theories of pure research point the way to new methods and new materials, as improvements on the old. It is of the greatest importance, however, to realize that this type of research is fundamentally related, in its promise of value, to the more purely scientific research which deals with new knowledge and new theories. The two cannot be separated. Industrial research, with its economic necessity for successful outcome, must learn this lesson first of all.

Industrial research in unsympathetic surroundings and without the guiding hand of fundamental scientific knowledge has sacrified at the start its chief hope of success.

If the principle set down in the foregoing paragraph is sound, and of this I think there can be no doubt, it becomes immediately obvious that the prosecution of successful industrial research entails highly trained research workers, thorough knowledge of the literature and work of the past and surroundings and contacts conducive to careful and well-run experimental programs. Not every industrial organization can set up these favorable conditions. Indeed, it is probable that the large majority cannot. It is here that co-operative research finds its great promise. Such carefully organized agencies as the Utilities Research Commission of Illinois, the Engineering Foundation of New York, the National Electric Light Association, and other similar bodies, with their wide professional relations, are in admirable position to insure judicious programs, competent staffs and other influences most promising of success. One of the most important questions for these bodies, therefore, is that of the conditions surrounding the numerous research activities in which they are engaged. Most of these projects, involving as they do manufacturing and production projects on large scales, will find their natural location in connection with existing plants. In these cases it would appear to be of especial importance that the experimental study should be guided by the best scientific knowledge. It is perhaps going a little too far to say that wherever possible industrial research should be conducted in connection with existing scientific laboratories, but I venture to believe that this statement is true. For a research laboratory, such as found, for example, in a university, provides: A group of scholars covering the whole range of science, intimately associated and devoted to research; an atmosphere not only sympathetic to research but existing especially for research; a library of past and current scientific literature; laboratory equipment of all description, and facilities for its construction. The value of these as applied to any problem of research is self-evident, and in view of the potential profit or loss no problem of industrial production, economy or improvement will have the same chance if deprived of them.

The dependence of applied science and industrial advance on fundamental scientific research is well exemplified in our present-day highly developed field of electrical science. It is probable that every important new principle in this field was first discovered, and in many cases subsequently developed, in a university laboratory, or by men highly trained in research in the universities. As examples may be mentioned: Electromagnetism by Oersted and Ampere, electrolysis and electromagnetic induction by Faraday and Henry, the magnetic effect of a moving electric charge by Rowland, X-rays and radio activity by Röntgen and Becquerel, the discovery of the electron by J. J. Thomson, radio transmission by Hertz. Coming to more recent development, it has recently been said that of some dozen or more men who have contributed to the hot cathode vacuum tube of today, and its manifold applications, with one possible exception every one was a university professor or his pupil. These illustrations, presented from my own field of science, could doubtless be paralleled by equally striking illustrations from other fields. Further, it seems safe to say that the remarkable achievements in recent years of such outstanding industrial research laboratories as those of the General Electric Company and the Bell Telephone System are due to the fact that they are directed by university men of high scientific attainments, who have surrounded themselves with highly trained men developed either in university laboratories or by similar processes of training.

Let it then be set down as a principle too often neglected that industrial research will have its best chance for success when planned in the full light of existing scientific knowledge, executed by men trained in research, and conducted under conditions most favorable for each.

Another difficulty retarding industrial research seems to lie in the fact that while the advances of today depend ultimately on research, it is not so easy to show that the advances of today depend on the results of research conducted today. Indeed, this is rarely the case. Neither Faraday himself, nor the industries of his time, reaped the enormous financial returns from his great discoveries. These profits came to others many years after. Some realization of this fact doubtless accounts for the hesitation of industry to engage in or to support scientific research more actively. Executives must be influenced by the thought of the next year's balance sheet and of the immediate returns from all activities, rather than in the problematical outcome, perhaps ten or twenty years hence, of a research program entailing continuous running expense. Few industries seem to have realized that research should be considered as a normal running activity, and that on the basis of its ultimate promise, on the protection afforded the results of research, the individual research laboratory is highly desirable, if not absolutely necessary. The value of such laboratories has been demonstrated in a few conspicuous cases, and there are an increasing number producing results of high importance to their respective owners.

On the other hand, it is not to be denied that laboratories of this type are expensive and are only possible as related to very large values of annual business. They are possible only to the largest and most powerful organizations, and it appears that other methods must be found for making available the results of contemporary research to the much larger number of important and progressive, though less powerful, industries.

Large company research not enough

If research is left by the smaller and less powerful companies to its own spontaneous and unregulated course in the pursuit of fundamental scientific knowledge in university laboratories, and in its application to industry to the larger laboratories of the more powerful organizations, the profits of research will remain with these latter. The opportunity of business in the mass for obtaining the benefits of research is that it should engage in co-operative methods for bringing together both scientific and applied research, with results available for all. In fact, this type of co-operation is now in force, in that there exist several industrial and national research agencies, as already mentioned, which are endeavoring to ascertain the problems of industry and to attack them with the knowledge and methods of both pure and applied science. An especial advantage of this type of co-operation is that it may draw on the knowledge and experience of wide ranges of skill and talent from both pure and applied science, and may select the locations of its various experimental studies as related to the respective problems under attack. Experiments may be conducted in the field on production scale, in university laboratories where more fundamental questions are involved, or in other suitable conditions when an intermediate stage of attack is needed.

Co-operative effort means co-operative support, and it is obvious that organizations of the character just described must depend ultimately on those industries most likely to profit by the co-operative research. Participation in this type of co-operative research, however, extends but slowly. This is due to the fact that the results of co-operative research are necessarily open and available, at least, to all those participating, and, in the case of several research agencies, open to the public through publication. Individual organizations may then well ask what returns they may expect from their support of co-operative research if its results are equally available to their competitors. The answer is that business finds its return in the opportunity for enterprise in competition, in bringing the results of research to the public. Public utilities find their return in the opportunities offered for better service, for increased facilities, for increased output, for lower prices, and the consequent increased confidence of the public. It is obvious that no single organization, whether in manufacture or in public service, can hope to control the results of co-operative research. But every keen and progressive organization can profit by the results of research, and can be successful in competition to just the extent that it is keen and progressive, and is willing to make success in competition the basis for increased business and profits.

Problems of Farm Service

What I think we need in this state are more good earnest round-table discussions of the problems of farm service (between farmers, utility executives and salesmen and regulatory commission representatives). At these meetings I believe it would be well to have in mind at least these six definite lines of study:

1. Getting indifferent utilities more actively into rural service. There are some companies yet which never get interested in rural business until some neighboring utility starts taking some of their prospective territory.

2. Standardizing rates and policies. Some try to satisfy us with the statement that in ten or twenty years irregularities will all be ironed out and rural rates standardized and simplified. We don't want to wait that long. What we want to know is what we can expect now.

3. Simplifying preliminary investigations before rendering service to expedite connection.

4. Developing some plan for taking care of the tenant and the poorer class farmer.

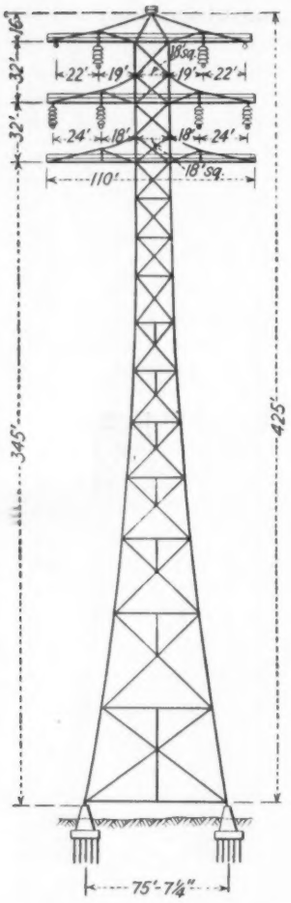
5. Impossibility of attractive return on all rural business during the development period. The most effective educational campaign is the prudent extension of lines into promising districts even though a profit cannot be expected for some time to come.

6. (This one to the farmers). Eliminating petty jealousies and the neighborhood squabbles. Don't be afraid to help your neighbor or relative to get service. The more business on the line the more beneficial it will be to you in the long run. Co-operate with each other.

J. HOWARD MATTHEWS,
Chief Engineer Illinois Commerce Commission, speaking at Illinois State Rural Conference.

Father of Waters Spanned in Four Days

By H. W. FURLONG
Structural Engineer
Stone & Webster Engineering Corporation, Boston, Mass.



Tower design emphasizes appearance value of easy curves

USE OF precut cables and development of an attractive tower structure with unusual facilities for access, combined with a rapid erection schedule, characterized construction of the double-circuit 132-kv. crossing of the Baton Rouge Electric Company over the Mississippi River near Baton Rouge, La. All six conductors and two ground cables for both approach and main spans were dead-ended at each tower and were cut to exact length and dead-end sockets installed in the manufacturer's shop prior to shipment.

An effort was made to obtain attractive looking structures by maintaining a parabolic slope to the tower legs, with well-proportioned crossarms above. The main leg members are rolled column sections, which emphasize the outstanding lines of the tower, reduce the bracing and number of redundant members to a minimum and result in a pleasing and simple tower outline.

The towers are painted alternate white and black bands and illuminated at night with red lights and the wires floodlighted with directional projectors to safeguard air navigation.

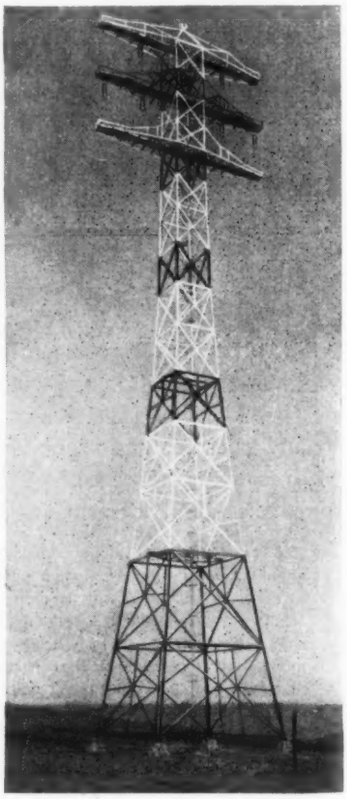
Access to the top of the main towers is secured by a continuous ladder system, with resting platforms every 15 to 18 ft. entirely inclosed in a separate cage structure extending the entire height of the tower with continuous walkways on the crossarms above and below all cables. It is believed that the safety and convenience for maintenance afforded by the complete means of access provided is justified for unusually high structures of this character.

Six months after the design had begun the crossing was ready for service, in accordance with schedule, the 425-ft. towers being completely erected in less than two months.

The actual stringing of the eight cables, consisting of 24 precut lengths, occupied four days, the suspension insulator assemblies having previously been completely attached in place on the main towers and the entire operation organized for efficient operations.

For the stringing operation each individual cable for the entire crossing was completed one at a time, and at no time were either of the main towers subjected to an unbalanced longitudinal pull of more than one cable. The river span in all cases was completed ahead of the land spans and final connections were made at the anchor towers.

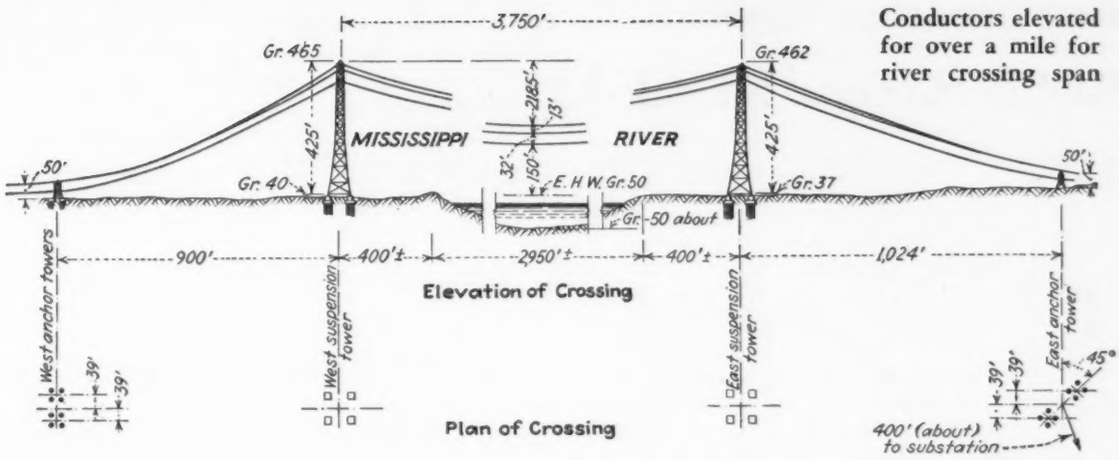
This was done because otherwise there would have been an unbalanced pull at the main towers prior to making connections of the river cable, which would have caused the insulators to swing away from the tower, increasing the hazard in making attachment and requiring consid-



Black and white paint increases visibility for aircraft warnings

Percentage Distribution of Cost of Crossing Excluding Right-of-Way

Structures—	
Substructure:	
Four anchor towers	7.7
Two main towers	20.3
Superstructure:	
Four anchor towers	4.0
Two main towers	52.8
Conductors	7.0
Ground wires	2.4
Insulators and assemblies	5.8
Total	100.0



Conductors elevated for over a mile for river crossing span

erable care to avoid overstrain of the crossarm in pulling the insulator assembly back to plumb.

It was also important to check the cut-to-length cables while they were being pulled up into place. The differential between the actual horizontal span and the length of the river span while being strung was about 25 ft. The corresponding difference in the land span was only about 7 in. An error due to incorrectly locating towers or wrong cable length could, with the aid of sighting boards, more readily be detected in the river span by following the above procedure and making final connection of all cables at the anchor towers.

The selection of a suitable conductor was principally a structural problem and the relatively low strength conductor chosen proved economical for design, and a stringing tension as low as 6,000 lb. simplified and expedited the stringing of cables.

Prevailing low water conditions and good weather favored the transporting across the river of the cables, which were mounted on a barge, one at a time, and payed out on the river bed through a sheave slung from a timber frame to prevent abrasion. No trouble was experienced in this operation from embedment of the cable in the river mud.

On the west side the hoisting cable passed over a sheave supported in the insulator assembly on the main tower, continued down through a sheave anchored to a deadman in the ground to a tractor, by which the cable was hoisted into place at the top of the tower. When the cable had been pulled out of the river and hoisted to within about 30 ft. of its final position with a tension of about 3,000 lb., the pull was transferred to the base of the west anchor tower and the final few feet raised by the tractor through a block and tackle.

On the east side limited working space and swampy conditions required the use of a stationary truck and niggerhead for attaching the cable to the anchor towers.

Major Design Features

Main Towers—Two, double-circuit suspension towers; 425 ft. high above concrete base, each weighing 217½ tons, with crossarms over 100 ft. in width.

Tie-back Towers—Four single-circuit anchor towers, 50 ft. high, each weighing 6½ tons.

Conductors—Six, 300,000-circ.mil, A.C.S.R. with 32½% area steel; over-all diameter 0.765; weight per lin.ft., 0.667 lb.; ultimate tensile strength, 23,400 lb.

Ground Wires—Two, same as conductors.

Minimum Clearance above Extreme High Water—About 150 ft.

Foundations—Concrete footings on creosoted wood piles.

Insulator Assembly—Main towers, equalizing yoke arrangement of double strings each of 16 high strength suspension. Locke No. 15010 units, having arcing rings top and bottom and estimated flashover of assembly of 2,700 kv. Anchor towers, same as at main towers, except twelve units per string instead of sixteen.

Provision made in all insulator assemblies for temporary installation of turnbuckles should replacement of insulator units be necessary.

Loading—Cables will be stressed to about 11,500 lb. with standard N.E.S.C. medium loading of ¾ in. radial ice and 8 lb. wind at 15 deg. F.

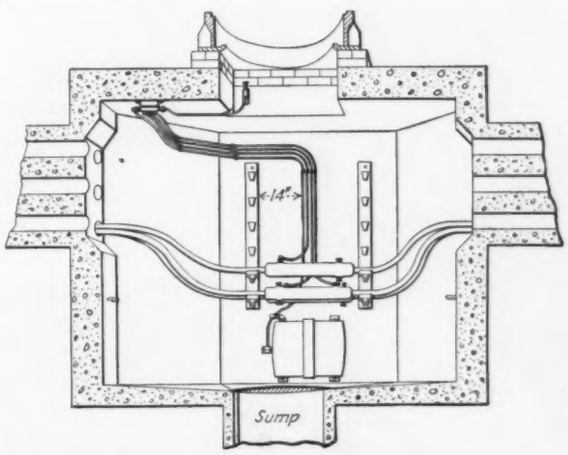
Main towers will resist at least twice the load produced by any two cables being broken when loaded as above.

Anchor towers will resist at least twice the load produced by all land cables being broken with the river cables loaded as above.

Both towers and cables will withstand an indicated wind velocity of 120 m.p.h. with ample margin of strength.

The crossing was built by the Stone & Webster Engineering Corporation.

One-Shot Oil Scheme for Cable Joints



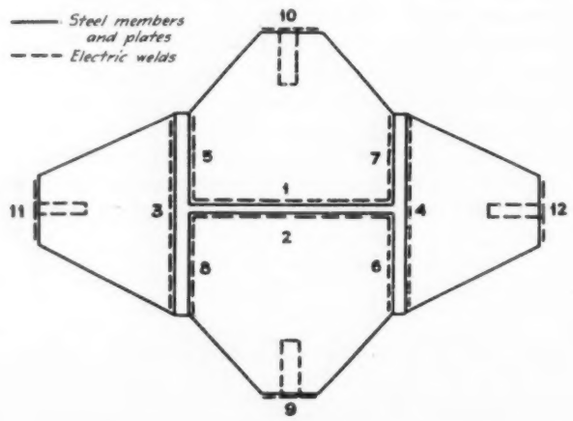
Filling heads for cable-joint oil reservoirs can be located in manhole chimneys according to a recent report of the underground systems committee on oil reservoirs and accessories for underground cables to provide a convenient means for maintaining oil levels in these installations. As is shown, oil lines are carried up from the reservoirs and from the joints to a manifold located on the ceiling of the manhole. From this manifold is extended a single line with the filling head turned up into the manhole chimney.

Welding Sequence Highly Important In Structural Members

That the school of experience is the best teacher was amply borne out in the electric welding of structural members in the new Southern California Edison building in Los Angeles. In order to make the building earthquake proof it was designed for horizontal forces as well as vertical loads. To accomplish this, floor beams were first riveted and then electrically welded to the vertical H columns so that full beam strength would be developed in the floor members. Entire dependence to develop this strength was placed in electric welding because of the saving in material and the much more compact detail of the welded connections.

The arrangement of plates and the extent of welding is shown by the accompanying illustration. In making the first welds at these points no effort was made to follow any particular sequence, but it was soon found that contraction stresses were breaking the welds as indicated. This led to experimentation as to proper sequence and after trying a number of combinations the sequence indicated by the accompanying sketch was adopted and no further trouble developed.

The importance of this experience is quite obvious and can hardly be overestimated.



Sequence for welding floor beams to vertical members avoids failures at points indicated

Making welds in the order shown and allowing each to cool between operations eliminated contraction stresses and welding failures.

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GOOD-WILL SERIES

How the Meter Department Can Help Public Relations*

By D. D. WILSON

Oklahoma Gas & Electric Company, Sapulpa, Okla.

As employees of the meter department we are the contactors of our industry to the public. We enter the homes and business places of the nation. We are practically the only medium through which most customers become acquainted with our companies. The attitude we assume is reflected right back on our companies.

The service man may be considered the first contact. The desire to render service and an appreciation of its value should be imparted to customers by him. He must be able to give satisfactory explanations of company policies and must have ability to define clearly matters relating to rates and to the uses of electricity. Familiarity with company policies, so that any question arising can be correctly and tactfully answered, are of supreme importance in this employee's ability on his job.

Second, there is the meter reader. This man also must understand company methods and policies and be capable of explaining them to customers. He should notice sudden increases or decreases in energy consumption and point them out to customers, thus often forestalling unjustified bill complaints.

Third, the meter tester. Meter registration, calibration and testing have always been sources of misunderstanding and it is this employee's duty to realize the importance of removing them as such causes. He must convince the customer that meters are accurate, precision devices and that periodic testing is a proof of the company's desire to keep them so.

Good relations established, the meter employee's next job is promoting increased use of energy. Some of us may say that we are not salesmen, but if we reflect that we sold some one the idea that we were worth employing we must admit that we do possess some selling ability. The first thing in selling is the perception of the prospective buyer's needs. When he is on the customer's premises the wideawake meter man will observe the presence or lack of electric appliances and equipments. He will talk to the customer and explain how electricity can be used with added comfort and convenience and with greater profit. By realizing on these opportunities many metermen discover that they are actually very good salesmen.

**From an address before an "Electrical Measurements Short Course," University of Oklahoma.*

Industrial Modernization— A Benefit to Community and Utility*

By MILTON O. NINGARD
Commercial Credit Company, Baltimore, Md.

MANY large and well-known concerns see the need for industrial modernization and realize the necessity for action. They come to the Commercial Credit Company to provide plans which permit plant improvement without financial strain. Such interested concerns include bankers, investment houses, business and engineering consultants, public utilities, large contracting companies, chambers of commerce and other related interests. Manufacturers desiring to finance their own plant improvements also come to us to work out their plans. These include textile mills, sugar mills, chemical plants, flour mills, lime plants, glass factories, printing establishments, refrigerating plants, hosiery mills, rubber goods factories, hardware manufacturers, etc.—almost all industry. I cite these to show that progress in plant design and improvement in machinery have not been limited to any particular field and that advances in all industries make modern plants necessary.

The community itself will exist only if its plants are modern. When factories close, move or operate at no profit, the effect on the community is bad. Standards of life are lowered and domestic electric consumption cannot be increased under such conditions. Sometimes the entire community will depend upon a factory and the prosperity of each is inseparable. Whole communities may vanish with the passing of their factories and the obsolete plant is one great industrial evil contributing to this. To preserve the industrial community is as important to the electric utility as to preserve its industrial load and both are dependent on modernization for their continued existence.

The utility is perhaps more dependent upon the industrial health of the communities which it serves than are the industrials located in them. An industrial's market is usually more extended and widespread than just the local territory and, accordingly, in many cases the factory can serve equally as well in another location, should conditions warrant change. But the utility business must originate in its own territory. It cannot follow the migrating industrial and, therefore, must assist its customers by making their problems mutual.

Adapted from address to Great Lakes Power Club.

The small town with one or two factories represents the ideal of industrial decentralization that makes for best social and living conditions of the population. As some of these scattered industries are modern in equipment and management, so are they in consequence more prosperous than others in which obsolete machines and hidebound executives prevail.

Since the prosperity of an electric utility is a direct reflection of the prosperity of the communities it serves, it is definitely to the interest of the utility to keep informed of factory conditions in its territory and to do the utmost that propriety and policy will allow to encourage industrial modernization.

The obsolete plant is a vicious factor affecting industrial community and utility growth. It causes losses that must be eliminated within the plant itself. If not, some other plant will take advantage of the condition and produce at a competitive advantage and will eventually put the first one out of business. In simple words, new equipment will replace the obsolete, either directly in the affected plant, or indirectly within another. It is certainly the modern plant that will determine future load.

Determination of obsolescence

The first step necessary is to decide what is the logical time in which new equipment must pay its cost. Two years, three years or even five years can be set, or a minimum return per dollar invested may be the criterion. In other words, when the investment will be repaid within the above-mentioned periods, or whenever a return of the determined amount is made on the investment,

then replacement becomes mandatory and prolonged waiting inexcusable.

Because of the admitted possibilities for reducing production costs sufficiently to pay for the necessary equipment an exact knowledge of plant conditions and improvement possibilities cannot be too highly valued. Whenever a new machine can be put to work producing at a lower cost, the means of acquiring a continuously modern plant is provided without increasing capital. Immediate purchase, without disturbing cash position, financial set-up or increasing output, is necessary, for knowing a plant is obsolete is admitting that replacement is necessary. Unless advantage is taken to reduce costs and make replacement present costs include a monthly loss that cannot be justified.

The adoption of a replacement policy, depending only on proof of obsolescence, without handicapping the issue with financial hold-ups, compels the purchase of equipment when economically necessary rather than when financially convenient. Commercial Credit Company, faced with the facts showing the need of industrial modernization and recognizing that more liberal financing was necessary than the limited terms offered by equipment manufacturers, has developed a plan of financing to allow the monthly earnings actually to pay for the installation. It was recognized that this was

> **a new field of financing, requiring credits certainly beyond the scope of the commercial bank, while at the same time, for the amount and time usually involved, unprofitable for ordinary methods of long-term financing**

Also, as much financing must be available whenever needed, and be not dependent on external conditions, a much more flexible and quicker means of financing becomes necessary.

Factors such as length of time allowed, initial payment necessary, proportion of total representing construction, etc., cannot be discussed at length here. But let me point out that usually the most necessary changes provide economies sufficient to pay all costs within the shorter periods, and the longer the estimated time needed to justify the installation the greater is the possibility for error. Even a large error or changed condition on a two-year deal may not extend it over three years, but a similar condition on a four-year deal will mean six years' time. We feel that the reliability and security of the longer term deal cannot be foretold with the accuracy of the shorter term, and in this field of financing our company limits its activities to three or, sometimes as an exception, five-year terms.

Depreciation cannot be charged against net savings and also against plant value when financing on a deferred-payment basis. A very flexible replacement policy is possible without tying up capital at the time and independent of budget restrictions. Concerns desiring to maintain a definite surplus or preparing to meet dividend obligations find financing from income is most logical.

So far our thought has been confined to the influence of the inefficient plant on utility load growth and a suggested policy of modernization, which is unhampered by financial hold-ups. Let us now consider any possible assistance that the utility can offer toward furthering this modernization program which will directly increase and improve the load curve.

Economy studies are made by industrial power departments to show savings obtainable by changes in power supply, and these form sales arguments for securing industrial load. Frequently, new equipment must be installed in connection with recommended changes. I wonder if incorporating the idea of payment from earnings would help eliminate many hold-ups that are not explained, but are often-times financial?

> **Utility co-operation plans coming to our attention have gone much further than would be supposed to bring about, and actually force, plant modernization within their territories.**

Have those prospects whose power and steam requirements cannot be solved by purchase of power been considered as having nothing in common with the utility? No doubt economic conditions demand spare capacity or a break-down connection. Why not recognize the possibilities for obtaining low cost energy and co-operate to reduce costs by tie-in, not just for break-down, but to obtain low cost peak power? This would be better than just a break-down connection, for when costs are low enough to justify the necessary plant expenditure, why not purchase as much excess power as is available from the industrial plant at a low cost, if it can profitably be used? This has been done in a few cases and also for gas supplies; so why not a more general adoption of the policy?

With a sufficient number of industrial plants tied into the utility system, furnishing it with low cost energy, such an arrangement cannot help but reduce central-station investment, while, at the same time, flexibility and reliability are not sacrificed. You thereby eliminate the capital investment in industrial spare plant, with correspondingly lower costs, which react to mutual advantage.

A worth-while extension of utility activity is the establishment of an industrial survey bureau. Any enterprise located or interested in the territory may submit its plans for the future to this bureau for analysis. Its products, markets, power requirements, future prospects, financing plans—in fact, every phase of the business and product—are studied and reported on from an unbiased viewpoint. Just the one field of co-operation with enterprises to improve load curve by off-peak-hour processing offers tremendous possibilities. Combining this service with suggestions for plant modernization can only result in greater industrial profits and more profitable load. The establishment of an industrial survey bureau is the beginning of a closer relationship between the industrial and the utility that cannot be achieved directly by the sales department.

In a nutshell

Summarizing, we find that community and utility prosperity are both affected by industrial plant modernization.

It is agreed that plant obsolescence must be recognized and that means of replacement without financial restraint are available to correct this condition. Likewise, ignorance will not render immune the plant that needs improvement. Improved methods and machinery are available in almost every industry and opportunities for cost reduction are not confined to any one field.

Careful economic study need not be the only policy governing equipment replacement, but this, being true,

emphasizes the need for conservative business judgment, as well as engineering facts, in recommending changes.

The present plant value must not be allowed to influence decision to such an extent as to hamper growth. It is better to recognize past mistakes or changed conditions and proceed to insure future welfare of the enterprise.

Last, the utilities are in enviable position to bring about improvements within their territories and are doing so through either industrial departments or subsidiaries organized for this purpose. Let us continue extending our efforts and broadening our activities to obtain the benefits that must attend improved industrial plant facilities and resultant community enterprise.

▼ ▼ ▼

Minimum Stress Indicates Cable Strength

By M. C. HOLMES

Department of Physics,
West Virginia University, Morgantown, W. Va.

RECENTLY published data on cable breakdown tests are collected and analyzed in the present paper for the purpose of determining the relative importance of the maximum and minimum stresses. The results lead to the unexpected conclusion that failures in strong sections of cable and failures in weak sections are governed by different laws such that in practice the limiting feature in determining breakdown voltage (and allowable operating voltage) is the minimum stress at the sheath rather than the maximum stress at the conductor.

The idea is not entirely new. It was advanced for the first time in 1921 by Fernie.[1] His conclusions, and the accompanying "skin resistance" theory for explaining them, were based on the results of a number of so-called "instantaneous" or short-time breakdown tests made on samples of cable having differing ratios of insulation radius to conductor radius (R/r see Fig. 1). The stresses at breakdown seemed to show a slightly greater uniformity among the minimum than among the maximum stresses. The idea did not meet with much favor, however, and the following year Fernie's "skin resistance" theory was definitely abandoned.

[1] *"Insulation Experiments," F. Fernie, "Beama," 1931, Vol. 9, page 244.*

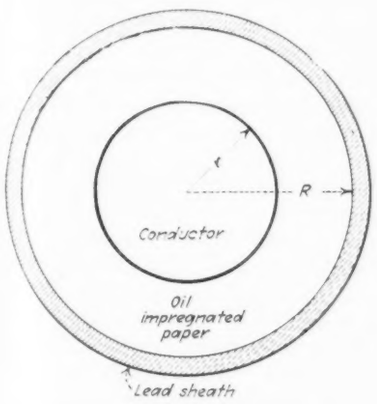

Fig. 1—Scheme of cable analyzed

The present paper is based on the results of a number of long-time tests—tests extending up to several hundred hours, and the results are analyzed in a different manner. No new theory is offered to explain the results. They are readily explained by well-known facts.

Data for the following analysis have been collected from published results of breakdown tests made on single-conductor cable. Only those results are considered in which time to failure was greater than one-tenth hour and in which sufficient information was given so that both the maximum and minimum stresses could be calculated. It is well known that failure depends upon time of application of voltage, or that time to failure depends upon applied voltage; thence, in order that the results may be more nearly comparable, they have all been reduced to the same time basis by means of the inverse seventh power relation, in accordance with the 1926 recommendations of the N.E.L.A. underground systems committee.[2] One hundred hours was arbitrarily chosen as a basis. The forms of the curves shown here, and therefore the conclusions reached, are independent of the time basis chosen. Due regard must be paid, of course, to the limitations of the inverse seventh power relations by keeping within the range for which it is known to hold. The original data have not been reproduced here. Calculated values are shown graphically and references are given to the original articles.

The two curves of Fig. 2 show how the maximum and minimum breakdown stresses are distributed. The height of any rectangle represents the number of failures which occurred within the voltage stress interval represented by the length of its base. The maximum stresses which occur next to the conductor surface at r (Fig. 1), are shown in the upper half of the figure, while the

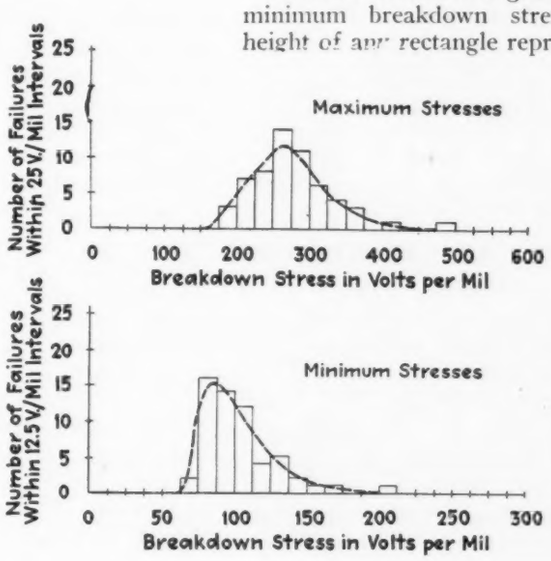

Fig. 2—Distribution of maximum and minimum breakdown values

[2] *Transactions N.E.L.A., 1927, Vol. 84, page 1426.*

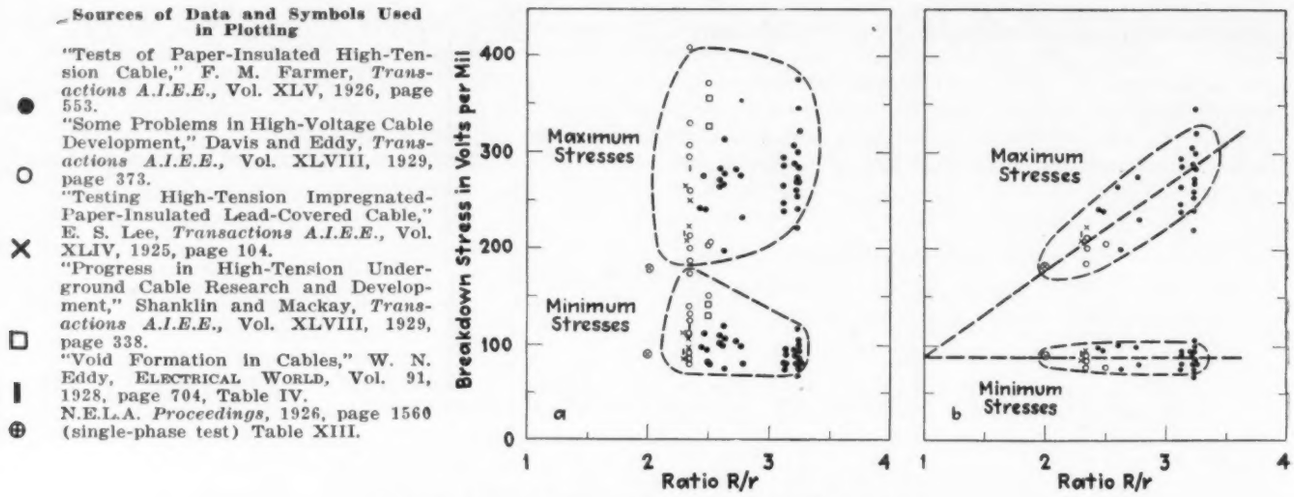
Sources of Data and Symbols Used in Plotting
"Tests of Paper-Insulated High-Tension Cable," F. M. Farmer, Transactions A.I.E.E., Vol. XLV, 1926, page 553.
"Some Problems in High-Voltage Cable Development," Davis and Eddy, Transactions A.I.E.E., Vol. XLVIII, 1929, page 373.
"Testing High-Tension Impregnated-Paper-Insulated Lead-Covered Cable," E. S. Lee, Transactions A.I.E.E., Vol. XLIV, 1925, page 104.
"Progress in High-Tension Underground Cable Research and Development," Shanklin and Mackay, Transactions A.I.E.E., Vol. XLVIII, 1929, page 338.
"Void Formation in Cables," W. N. Eddy, Electrical World, Vol. 91, 1928, page 704, Table IV.
N.E.L.A. Proceedings, 1926, page 1560 (single-phase test) Table XIII.
Breakdown Stress in Volts per Mil
400
300
200
100
0
Maximum Stresses
Minimum Stresses
a
1
2
3
4
Ratio R/r
Maximum Stresses
Minimum Stresses
b
1
2
3
4
Ratio R/r

Fig. 3—Breakdown stress related to radius ratio

(a) All data included. (b) Including only data corresponding to lower half of points in distribution curve for minima and the corresponding maxima.

corresponding minimum stresses are shown immediately below. The amount of data is not sufficient to form a smooth distribution curve; the approximate shape of the distribution, however, is shown by the dotted curve. Maximum stress distribution is seen to be nearly normal; the minimum stress distribution, on the other hand, is quite definitely skewed, indicating a critical stress at about 75 volts per mil. The value 75 volts per mil, it should be remembered, refers to a time basis of 100 hours. If it could be reduced to a time basis of one year by the same inverse seventh power relation its value would be approximately 45 volts per mil. The difference in the shapes of the two curves is significant and indicates the importance of considering minimum stresses.

The scatter-diagram of Fig. 3 shows all of the data plotted against the ratio R/r. Due to the inherent variability of the insulation itself, as well as to differences in test conditions, the points are quite scattered. The existence of any critical value among the minimum stresses is not so apparent as in the previous figure. At this point one might be tempted to leave the analysis. The next step, however, and the accompanying reasoning is believed to be important and leads to a rather striking confirmation of the idea already suggested by the curves of Fig. 2.

Minimum independent of radius ratio

The reasoning connected with the next step, and the justification for it, is as follows: Consider a long cable as being made up of a number of sections of insulation connected in parallel. Failure of such an arrangement depends upon the strength of the weakest section, no matter how strong the strongest sections may be. Furthermore, it makes no difference how many strong sections a cable contains. If it contains but a single weak section it will fail. Consequently, in studying test results, samples showing the lowest values of breakdown strength, considered as weak sections, are the ones to be studied most carefully. They are the important ones. The strong samples, paradoxically, are not important. With this in mind, samples in the lower half of the minimum stress distribution were taken and plotted, as before, with their corresponding maximum stresses, against the ratio R/r. The results are shown in Fig. 3b. Here the minimum stresses lie along a horizontal region, indicating a definite breakdown stress independent of the ratio R/r. Both regions indicate coincidence at the value of R/r equal to unity, as should be the case, since at that point the two stresses are equal. These results point to the minimum stress as the limiting one for samples in the lower half of the distribution. A similar analysis of points in the upper half, while by no means so definite, points to the maximum stress as the limiting one for those samples, as would ordinarily be expected. The conclusions are as follows:

Failures in weak sections of cable and failures in strong sections of cable are governed by different laws. Breakdown of weak sections depends upon the stress at the sheath; that is, upon the minimum stress. Breakdown of strong sections, on the other hand, depends upon the stress at the conductor surface; that is, upon the maximum stress. In practice, therefore, since failure of the entire cable depends upon the strength of its weakest section, the minimum stress is the important or limiting feature in determining breakdown voltage or allowable operating voltage. These conclusions, it should be pointed out, apply only to the type of cable considered, namely, to the ordinary "solid" type of single-conductor, oil-impregnated, paper-insulated cable.

An explanation of the phenomenon is undoubtedly to be sought in the rather generally accepted view that failures in cable insulation are due, in some way, to the presence in the insulation of ionizable voids, and that these ionizable voids have a tendency either to form in, or to be forced into, the region next to the sheath where their ionization depends upon the value of the minimum stress.

The foregoing offers an explanation of the failure of attempts at grading, since the customary method of grading would be such as to result in an increase of stress at the sheath and hence a lowering of the breakdown strength as a whole. It also explains the puzzling failure to observe any appreciable difference in strength between cables made from smooth conductors and those made from stranded conductors. The design of the modern type H cable tacitly assumes the importance of the stresses at the sheath by shielding the ionizable voids in that region from the electric field.

Deprecates Value of Holding Company Regulation*

By HENRY C. ATTWILL

Chairman Massachusetts Department of Public Utilities

LOOKING at holding company regulation by a state commission from the standpoint of the rate payer, I feel that there is no particular advantage in it. Our commission has discussed this matter many times. One of the disadvantages is that we are likely to dissipate our energies chasing the owner of the stock rather than seeing to it that the operating company gives good service at reasonable rates. We felt that it might involve us too far afield in our examinations and hearings and that it would have a tendency unduly to protract our hearings on things which were in our judgment inconsequential.

When we have a hearing in this state it is rather a free-for-all affair; we do not like to shut off anybody, otherwise he thinks he is being abused, and the result is we conduct our public inquiries more or less like legislative committee hearings. We naturally want to hear, and we do hear, whatever any one has to say, although it may be pretty far afield from the main problem, viz., that we shall get good service and at as reasonable rates as the judgment of the commission feels that the utilities ought to give them.

"Birdshot" regulation wastes effort

We have no pronounced objection to it, and we have sort of a conviction that it is better not to use too much birdshot in regulatory matters, but to go at the real thing that we are interested in.

If you view holding company regulation from the standpoint of the investor, I assume that there is some merit in this proposition, but I had always supposed the regulation of public utilities, at least the major thing we had in mind, was the regulation of rates.

If the holding company kept outside of the state I do not suppose we would have any jurisdiction in the issue of securities any more than we would have over some corporation in New York or New Jersey. In regard to the formation of a holding company (within the state) which is beginning to acquire a very large percentage of an electric company stock, I do not think that we can do anything, but I assume we might pass upon the issue of bonds at least. Our statutes provide that stock and bonds shall not be issued except as approved by the department as being reasonably necessary for the purpose. Other certificates of indebtedness, like notes, etc., can be issued to mature at a period three years or more from the date of the issuance. Now a trust certificate, in my judgment, is neither a share of stock nor a certificate of indebtedness, and so, as the act is now drawn, I do not think we will have any control over the issuance of trust certificates, but we would, I assume, have some control over the amount of bonds issued by the holding company.

Quality of management most important

Considering whether operating companies have suffered either from inability to borrow money freely at proper interest in the open market or from excessive centralized management fees, the answer is always different. When I first came in the department there were some utilities operated by Stone & Webster. There was a good deal to criticise in the terms of their contracts, and also perhaps in the charges made, but the singular thing about it was that those companies that were managed by Stone & Webster seemed to be producing the best results for the public. Thus it is not always a question of

*From a recent statement before the committee on power and light of the Massachusetts Legislature.

simply how much is paid out for management. We have got to look further in and find out what kind of management the company is getting.

It is as though I hired an engineer at $50,000 a year. Somebody might be shocked at it and say that I only ought to pay $5,000 or $10,000, but it may be that I am exercising sound judgment in having the $50,000 man because I am getting a better type of management. After all, the proof of the pudding is in the eating thereof. The results obtained are the important thing.

I do not like the idea, but there is some truth in the contention that in having four or five companies with a high-class engineering force one gets a better type of engineering than by running the individual company with an engineer of the type that the company could afford. It is a good deal like a school superintendent up in the country, where they cannot afford in one town to employ such a man, but by combining they get a better type of superintendent.

As for interest, we have had instances brought to our attention where holding companies have loaned the local company money and charged perhaps an excessive rate of interest. But in considering the question of rates one must add the interest to the dividend and see how it works out. I think when the Cambridge company was acquired by the Associated System the latter reduced the dividend—in fact, abolished it—and loaned the company money, took over the bank loans and charged more interest than perhaps the company could have got from the bank, but the question we must figure, it has always seemed to me, is the total amount taken out for interest and dividends. If we have a rate case and see that operating expenses are too high and that they are paying out too much interest, we can mentally calculate what the rate ought to be and will disallow certain operating expenses. We may not say it in the opinion, but we do it as a practical matter, and this effects a measure of holding company supervision from the rate payer's standpoint.

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Prize Winners in Advertising

PUT an ELECTRIC OUTLET on EVERY WALL
get full service of electricity—for a few cents a day!
1 cent
COMMONWEALTH EDISON COMPANY

Chicago captured the honors in the National "Better Copy" contest of the Public Utilities Advertising Association, according to the announcement of prize awards made June 16, at the New York convention of the association. Commonwealth Edison Company won first prize, new-business section, with the newspaper advertisement, "1 cent." Public Service Company of Northern Illinois placed second in the electric poster section and third in the merchandise section. Utilities Power & Light Securities Company won third prize in the financial section.

General and Supplementary Lighting Components

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

Notwithstanding the many factors involved in lighting for seeing, the means available to the lighting specialist for improving seeing are relatively few compared with those available to the seeing specialist. Among these, quantity of light, or foot-candles, is by far the most effective for universal application. This is assuming that the light is skillfully utilized and that objectionable byproducts, such as glare, are minimized. However, the utilization of quantity of light as a means for improving seeing is usually curtailed by the cost of the lighting before adequate levels of illumination are reached. This is particularly true in situations which demand critical visual work and correspondingly high levels of illumination. It has been established that the following steps in level of illumination are required for approximately equal improvements in seeing and that the intervals indicated represent about the minimum improvement that seems justifiable.

Foot-candles

1	2	5	10	20	50	100	200

It is evident from this scale of foot-candle effectiveness that the cost of making each successive improvement in level of illumination becomes increasingly great. Nature attains excellent lighting by a lavish use of foot-candles, but economic factors prevent the lighting specialist from achieving the same result by so simple a process. By supplementing the general lighting with localized lighting at places where critical seeing is demanded further improvement is economically possible.

The definite illumination objectives indicated by this scale of foot-candle effectiveness facilitate an analytical study of lighting problems. General lighting and supplementary lighting are two components involved in attaining the higher levels of illumination. The relative magnitude of each component is determined by the character of the visual work to be done. In some lighting installations the general lighting component will be of major importance; in other situations the fundamental assistance to vision will be supplied by the supplementary lighting component. It is obvious that the supplementary lighting component becomes of increasing importance as higher levels of illumination are sought.

These steps in level of illumination represent various possible magnitudes of the general lighting component and, in conjunction with the visually desirable level of illumination, determine the magnitude of the supplementary lighting component. It is also evident from this series of foot-candle values that the number of possible combinations of general and supplementary lighting for a particular case is not necessarily large, owing to the limited number of steps in the series. Therefore, it is practically possible to appraise and compare the cost of attaining a visually adequate level of illumination by several combinations of general and supplementary lighting.

Continuous Water Heating at $5.10 per Month*

Low-wattage continuous service.
620 installations in twenty months.
50-gal. copper tanks with 1,500-watt split units.
1.5-cent energy rate.
Installed price now $199.50.

By GEORGE S. WILLIAMS
Vice-President and General Manager
Central Maine Power Company

OFF-PEAK problems in connection with water heating are keeping many central-station men busy with technical problems which seem to have little bearing upon conditions on the Central Maine Power Company system. This property is operated almost entirely by hydro plants, its customers being widely scattered through some 200 cities, towns and villages. In the fall of 1928 the Wyman development at Bingham was begun, to produce about 300,000,000 kw.-hr. per year, and the business in sight accounted for about two-thirds of this output. Steadily increasing demands for rate reduction were faced and immediate steps had to be taken to increase the annual energy consumption per home, then only 336 kw.-hr. Domestic water heating had an appeal as a load builder which could not be overlooked, and following preliminary tests it was decided to standardize on a 50-gal. copper boiler, properly insulated, with a split circuit unit of 500 and 1,000 watts. By January 1, 1931, 620 heaters had been sold, and this activity, with other sales efforts, raised the energy consumption per home to 438 kw.-hr. for the year 1930, the average use of energy by each water heater being 4,080 kw.-hr. per year.

Low-wattage units were favored by us as involving small chance of upsetting company policies as to peak-load demands and causing any heavy increase in capital investment. They are simple to merchandise and install after due employee training and suitable sales effort. We desired to merchandise a 1,500-watt appliance in order to cut down wiring costs for the customer and the demand on our distribution transformers and secondaries. Thirty-gallon boilers would not take care of the average consumer without higher wattage. Off-peak operation would require from 2 to 4 kw. on a 50-gal. boiler, and it was a case, if operating off-peak, of higher wattage or a larger tank. A 100-gal. tank would have brought in building estimates.

We employed a technically trained mechanical engineer with steam and hot water experience to direct the work, under the commercial manager. He spent three weeks at the factories. It is his duty to inspect the piping in every home buying a heater and to co-operate with the local plumber. By a sales meeting attended by manufacturers' representatives, company officials, executives and commercial department forces, through the preparation of a water-heating manual, territorial meetings, advertising and displays, water heating was made real to employees. General acceptance of its practicability followed the realization that sales efforts would not be tied up with a lot of needless detail and technical problems. The subject was continually kept before our employees, who received stimulating sales commissions.

We sold 225 heaters in eight months of 1929 and 395 in 1930. These yield $5.10 per month per heater on our 1.5-cent energy rate. They were sold and installed for $150 cash and $165 on time. Of the 620 heaters, only 10 per cent required 3,000 watts and 3.5 per cent had to be connected in series to provide 100-gal. capacity. The customer requiring more than 50 gal. capacity on a 24-hour basis on our system is special and exceptional. Our average installation cost for wiring and

**From a paper before the Commercial Section, New England Division, N.E.L.A.*

piping was $28.26. Only minor adjustments have been required in the few service calls necessary.

We are now proceeding on the basis of selling these heaters installed for $199.50, which affords a fair profit to dealers and contractors and encourages their sales efforts. As far as our company goes, we feel that the preliminary stages are over.

Our residential cooking and heating rate in force prior to the water-heating development included an energy price of 3 cents per kilowatt-hour for the first 30 hours' use of the demand per month, 2 cents for the next 60 hours' use, 1.5 for the next 210 and 1 cent above 300; minimum charge $2 per month for the first 7 kw. of demand.

Some of our men felt that we ought to have a special water-heating rate, so we filed an exclusive water-heating tariff of 1.5 cents per kilowatt-hour, with a minimum charge of $4 per month, on separate meter. It was surprising to see how many of our range customers were waiting for a water heater that could be operated at a reasonable cost. Seventy-five per cent of our heater sales have been to range customers, many of whom have earned a 2-cent or a 1.5-cent rate by their total usage under the residential heating and cooking tariff.

Away with the off-peak bugaboo

It seems to me we are getting more or less "fussed up" over load charts, peak-load demand investments and the application of enough "gadgets," "gimmicks," etc., so that before we get through we may be decorating one of these low-wattage storage tanks or the customer's entrance cabinet so that it resembles the chest of a retired general attached to a foreign legation. We have always had to care for daily load peaks, but now the steadily increased sale of household appliances has broadened out the 24-hour curve to a point where there is at present little to worry about.

We cannot expect to sell load-limited appliances to our customers in these days. We tried it in the industry with ranges, but when we found out the diversity factor of domestic electric cooking, every one was more or less ashamed of the idea, and I doubt now if it is ever mentioned. Now we are getting into the same kind of confusion with water heating. You cannot run a water-heating campaign on the basis of failures in service at the faucet resulting from the functioning of off-peak devices.

Recently we surveyed the operation of 60 heaters with 90 kw. connected load over a week-end. On Saturday noon their peak was 50 kw. A gradual decline followed to a minimum in the night of 10 kw., increasing to a Sunday noon peak of 40 kw. Monday is washday in Maine. Between 10 a.m. and 1 p.m. the heaters reached 54 kw. peak, dropping gradually to 10 kw. during the night. Heaters help to fill the noon valley as well as to improve the system load factor. Tests show a diversity factor of 1.6 for these water heaters, from 55 to 60 per cent load factor for 24 hours and an annual energy consumption of about 4,000 kw.-hr. per heater.

If we should sell 5,000 water heaters on our property, based on a diversity factor of about 1.6 and averaging, say, 900 watts per heater, the load would be 4,500 kw. What operating company is there, requiring plant capacity to supply 60,000 to 80,000 kw. demand, that does not have two or three times this amount ready to handle swings on any well-balanced interconnected system? A dark cloud passing across the sun might increase the system load by two or three times this heating demand. Load curves can be adjusted by selling energy to certain industries that can take advantage of off-peak. Why burden the poor domestic customer?

Investment for maximum demand

We know from experience that we can build a floating steam plant of 20,000 kw. capacity for $80 per kilowatt and generate energy at almost one-half what it costs in some of the stationary steam plants. I cannot imagine having much above $200 per kilowatt invested in transmission and distribution. Therefore I consider it more or less unfair to use such a high kilowatt cost as $500 (as in a recent paper) as an argument for off-peak installations. At the Wyman development at Bingham, Me., the river is probably good for an average of 50,000 to 60,000 kw. When this plant was designed it was planned to install three 25,000-kw. units. Normally we would operate two of these. Back of the development is a storage reservoir of about 8,000,000,000 cu.ft. of water. The probable cost of that additional unit in the development could not be more than $500,000, or $20 per kilowatt. You could operate a unit of this size to handle any peak loads for an hour or two that might occur in the state of Maine and have some capacity left to correct the peak in other parts of New England. The unit is still available when the flow is above the average to obtain revenue from the sale of surplus power. With developments of this kind it is unnecessary to spend much time worrying about how the installation of a 1,500-watt water heater will affect plant investment.

My views apply to a property operated almost by hydro-electric plants. We have to provide for varying load conditions and build our storage reservoirs accordingly, having a floating steam plant available in emergencies. If an additional 25 per cent saturation of range business could be realized, the average domestic consumption would be increased from 512 to 856 kw.-hr. An additional 50 per cent saturation would bring this to 1,200 kw.-hr. If we could obtain 25 per cent additional saturation on ranges and 25 per cent on refrigerators on existing lines, the average domestic consumption would rise more than 1,000 kw.-hr. annually. If range, refrigeration and water-heating business on existing lines rose 25 per cent, we should reach 1,756 kw.-hr. per year. These results cannot be achieved by bringing too much technical detail into these customer installations.

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Electrical Engineering Draws Many Recruits

No other branch of engineering is taken up by so many students as electrical engineering, according to a study, "Electrical Engineering as a Career," prepared by Walter J. Greenleaf, associate specialist in higher education, and issued by the United States Office of Education, Department of the Interior. The study is based on facts and statistics gleaned from more than 100 American institutions which offer engineering training and also from graduate engineers throughout the United States.

"It costs an average of $208 tuition per college year of nine months to receive electrical engineering training in one of the 118 universities or colleges which furnish such an opportunity in America, although the tuition and fees range from a few dollars in the state universities to $500 in the Massachusetts Institute of Technology," the inquiry reveals. "Only about 40 per cent of those who begin the electrical engineering study graduate."

"There is no uniformity in the granting of first degrees to electrical engineering graduates," the study says, "and there is no organization which accredits or evaluates engineering schools. Recommendations of the Society for Promotion of Engineering Education, offered in 1910, have been widely accepted as standard."

Salaries of electrical engineers average a little more than $3,600 annually, according to the survey. Electrical engineers out of college two years receive an average annual salary of $1,989, those out of college five years $2,889; out of college ten years, $4,231; out of college fifteen years, $5,357; out of college twenty years, $6,452; out of college twenty-five years, $7,656, and those with thirty years' experience since leaving college average $8,141. Less than 6 per cent of those included in the survey earned $7,500 or more.

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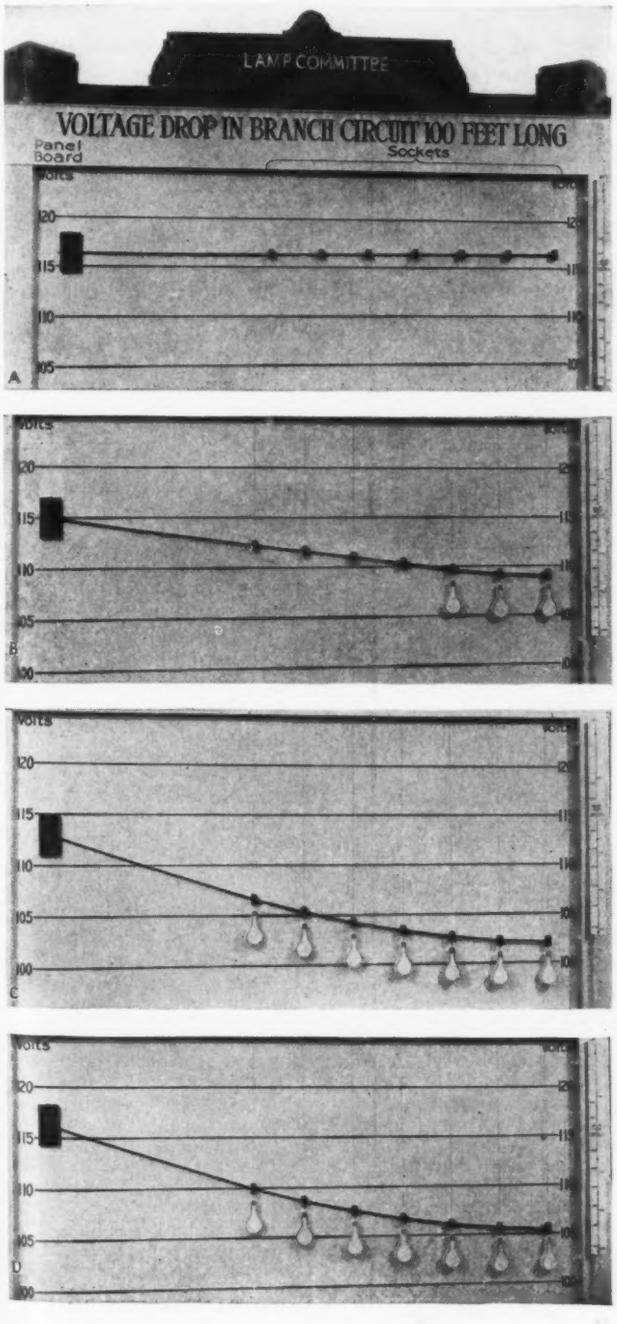
Animated Chart Portrays Effect of Adding Loads



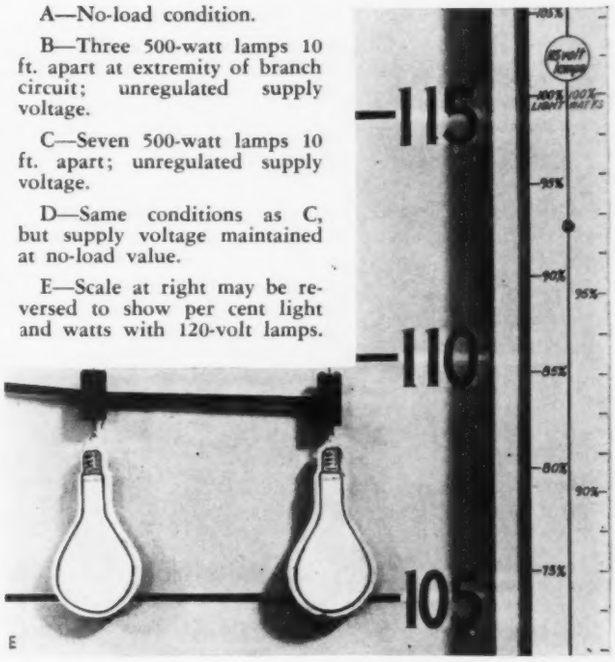
A—No-load condition.

B—Three 500-watt lamps 10 ft. apart at extremity of branch circuit; unregulated supply voltage.

C—Seven 500-watt lamps 10 ft. apart; unregulated supply voltage.

D—Same conditions as C, but supply voltage maintained at no-load value.

E—Scale at right may be reversed to show per cent light and watts with 120-volt lamps.



Builders of new buildings and owners of those which have obsolete wiring can be given a visual appreciation of the effect which poor voltage regulation and improper selection of lamps will have on illumination by the animated chart displayed at the N.E.L.A. convention by the lamp committee.

Set the center of the left block at the regulated or unregulated no-load supply voltage and suspend weights corresponding to the loads on hooks attached to the articulated horizontal bar and the latter will adjust itself to show the effect on the supply voltage, the voltage at any point on the branch circuit and also the per cent of rated light and watts at each socket.

The chart is based on a No. 14 branch circuit 100 ft. long to which various loads may be attached at 10-ft. intervals starting 40 ft. from the branch-circuit supply. Multiple suspension of the articulated bar by cords attached to different points on a helical spring permits readings which are so close to calculated values that the difference is inconsequential, according to reports.

READERS' FORUM

Using D.C. Experience in A.C. Circuit Breaker Design

To the Editor of the ELECTRICAL WORLD:

Referring to the ELECTRICAL WORLD editorial entitled "Oil Breaker Theory," in the February 7 issue, the present state of the art is best expressed by the first part of the last paragraph:

> The phenomenon of arc interruption in oil is not a simple matter. It embodies the deionization theory, the effects of solid oil spray and globules, the pressure and temperature conditions, the mechanical arrangements, the oil characteristics and the energy dealt with. No one theory or principle will explain the action.

Of the several factors mentioned in this quotation it is believed "the mechanical arrangements" have not been given the consideration possible in most oil circuit breaker designs, particularly with reference to the relative speed of contact movement to circuit voltage and characteristics, the proper control of and rate of acceleration and deceleration of the moving contact elements and a mechanical design that will carry out the intent of the designer under installation and operating conditions with a moderate inspection and maintenance expense.

While it is true that practically all of the oil breaker designs in use utilize two or more of the "factors" or "characteristics" of operation, it is not felt that any, until very recently, have endeavored to approach contact speeds known to be desirable. The speed should be such that contact separation equal to 1 in. of break in oil for each 5,000 line volts is made in the time of one-half cycle at 60 cycles or somewhat less. This assumes a clear break distance in oil and that the arc will be broken at approximately one-half travel and therefor within the first full cycle 60 cycle, or half cycle 25 cycle. The presence of "explosion pots," "grid frames" or "arc chutes" in the arc stream will require some further contact separation for safety.

> These assumptions, applied to our present highest operating voltage of 220 kv. and further assuming the possibility of full voltage across each pole, require 44 in. of contact separation within 0.008 of a second, or an average speed of contact separation of 440 ft. per second or 300 m.p.h. if a single break is assumed. However, multi-break contacts are now the rule, and if ten breaks are assumed this speed of contact separation could be obtained with an average speed of 44 feet per second or 30 m.p.h. Further assuming practically "straight line" or constant acceleration and deceleration to and from the maximum contact tip speed of 60 m.p.h. (88 ft. per second) it would require approximately 700 lb. of accelerating effort for every pound of mass to be moved at this speed. However, most of the contact and operating mechanism elements would be operating at much less speed or radius of gyration than the arcing tips in any design contemplating such speeds, and therefore the problem is not as formidable as it appears, especially for breakers of lower voltage.

At the lower operating voltages the current volume is relatively large, say above 5,000 amp., causing a high degree of ionization in a portion of the arc stream from volatization of contact material; the circuit characteristics are such that the voltage has a very rapid rate of recovery because of a large reactive or capacitive component or both, thereby approaching a resonant condition; the minimum contact separation is necessarily several inches.

The presence of oil in the path of motion of the contacts will effect the speed-time curve somewhat by decreasing the acceleration, but as it would also increase the deceleration the average speed for the total contact separation would be approximated. Only a small portion of the total moving mass would be displacing oil at the higher speed in any appropriate design and the cross-section of same made to minimize cavitation and resistance to motion. Most of the moving mass could be arranged to avoid displacing the oil or would be outside. The rapid arcing contact motion would inherently leave solid oil masses in the arc stream and, together with the turbulence created in the oil by the rapid motion and the several arcs, could be directed to assist in the process of arc quenching.

The general trend of development of devices for improving the process of a.c. circuit interruption follows the methods investigated, tried out or adopted in connection with high power and moderate voltage d.c. circuit interruption. My experience indicates that both the rate and magnitude of the recovery voltage rise, as well as the magnitude of the current, determine circuit interrupter duty in oil, air, or other medium on either alternating or direct current.

> One of the most severe field test set-ups of my experience was clearing a short made at the load end of several underground cables in parallel, with a breaker cut in between the bus and the battery of cables. Ordinarily a breaker is only required to handle a "short" through one of these cables, but in this set-up the entire output of the bus was temporarily carried by this test breaker. The current magnitude and rate of voltage rise were both high, the rate approaching that of a simple d.c. circuit containing resistance only.

It has been the writer's experience that an unconfined or undirected arc, in either air or oil of either direct or alternating current of any considerable power, is likely to be extremely erratic and out of definite control both as to the problems of insulation and interruption. The problem is efficiently to confine and direct the arc while limiting its volume and effects. All of the schemes discussed herewith have these general objects in view.

The industry adopted the so-called "carbon circuit breaker" for heavy-current, moderate-voltage service largely because of the superior arrangement of the main, auxiliary and arcing contacts which caused the arc to travel upward away from all contacts by means of the inherent magnetic and expulsion blowout action.

Modern air type breaker designs for both a.c. and high-voltage d.c. combine the structural arrangements of the "carbon" type with powerful series type magnetic blowout and liberal arc chutes containing energy reducing and absorbing means to quench the arc quickly. Some of the moderate voltage forms include a large number of arcing circuit gaps to utilize what we used to call the "inherent arc counter electromotive force" of the gaps as indicated by arc steam exploration.

> In certain 5,000 volt d.c. railway experimental work about twenty years ago we tried out the water break type of breaker with good results. Later, in circuit interrupter development for auxiliary circuits on 3,000-volt railway equipment, a multiple metal screen inclosure for directing and condensing the arc gases, similar in principle to that used in the Davy miner's lamp, was found to be effective in confining an arc in air.
>
> A successful application of the air blast principle of circuit interruption has been used on the pressure governor switches of electric railway air compressors for the past twenty years. It was found necessary to have an appreciably persistent blast of air to prevent arc re-establishment on inductive circuits.

J. N. MAHONEY,
Consulting Engineer.
Brooklyn, N. Y.

Men of the Industry

G. A. Davis Vice-President of Oklahoma Utility

GEORGE A. DAVIS, for more than ten years assistant to the vice-president of the Oklahoma Gas & Electric Company, has recently been elected vice-president of that utility in charge of public relations. Before entering the public utility industry Mr. Davis had had varied and extensive experience in publicity and advertising work.

While attending college he engaged in newspaper work and following graduation be joined the staff of the Chicago *Journal*. Subsequently be became interested in theatrical work and handled advertising and publicity for Florenz Ziegfeld, Charles Dillingham and other New York producers. Mr. Davis was identified with the advertising department of the Byllesby Engineering & Management Corporation in Chicago before removing to Oklahoma.

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R. S. MCCARTY, advertising manager of the Philadelphia Company for the past five years, has been elected president of the Public Utilities Advertising Association.

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H. L. WILLS, who has been connected for many years with the public utility industry in Georgia, has established a consulting practice with offices in Atlanta. Mr. Wills is specializing in the adjustment of relations between telephone, telegraph, railway signal and automatic train control systems, and also on problems of electrolysis and radio interference. He has held many operating and executive positions with the Georgia Power Company and predecessor companies, including that of engineer, electrical engineer and operating manager and assistant to the vice-president and general manager. Mr. Wills has maintained an active interest in the National Electric Light Association, American Institute of Electrical Engineers and other societies.

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C. E. Skinner, assistant director of engineering of the Westinghouse Electric & Manufacturing Company, has been appointed as the representative of the American Standards Association on the Council of the International Standards Association.

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CHARLES C. MOORE, for about 30 years president of C. C. Moore & Company, Engineers, Inc., San Francisco, has retired from active participation in the management of the business and has become chairman of the board. ELGIN STODDARD, who has been vice-president for about 25 years, succeeds Mr. Moore as president of the company.

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WALTER W. COOPER, who recently completed his contract as rate expert for the East Bay cities and other California municipalities, has been named supervisor of rate proceedings for the Railroad Commission of the State of California with the title of director of research. Mr. Cooper will have charge generally of the preparation of cases before the commission and will maintain a constant check on rate structures and earning conditions of the utilities. He has had valuable training and broad experience in rate matters before the California commission and other regulatory bodies throughout the country.

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NICHOLAS GERTEN, formerly vice-president of the Blaw-Knox International Corporation, New York, has been elected president of that organization. Mr. Gerten joined the Blaw-Knox organization in 1928 as sales manager of the Blaw-Knox International Corporation. He was formerly an engineer in the technical department of the Mitsubishi Company in New York and prior to that was with the Allied Machinery Company, a subsidiary of the American International Corporation, engaged in the export of American machinery. Mr. Gerten is a graduate of the University of Illinois, class of 1917.

A. B. Day Heads Pacific Coast Association

A. B. DAY, who was elected president of the Pacific Coast Electrical Association, as announced in the July 4 issue of the ELECTRICAL WORLD, is thoroughly familiar with electrical conditions in that section of the country, having been associated with the public utility industry in California for more than 35 years. At the present time Mr. Day is president and general manager of the Los Angeles Gas & Electric Company.

It was in 1895 that Mr. Day became identified with the Los Angeles Gas & Electric Corporation and in the course of time, advancing in the ranks, he acquired a comprehensive knowledge of the company's business, both financial and operating. He served successively as bookkeeper, chief clerk in the gas department, chief clerk in the electrical department, auditor, assistant secretary, manager of operation, general superintendent, vice-president, executive vice-president and general manager and three years ago he was elected president. For a number of years Mr. Day has been actively interested in the affairs of the association which he has just been selected to head.

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JULIUS DANIELS, assistant superintendent of the promotion department of the Edison Electric Illuminating Company of Boston, has been elected presi-

dent of the Illuminating Engineering Society. He will take office at the annual convention of the organization in October.

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GEORGE M. RICHARDSON, purchase engineer of the Southern California Edison Company, Ltd., was elected president of the National Association of Purchasing Agents at the convention of the organization held recently in Toronto.

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ERNEST W. NELSON has been appointed sales manager of the Pittsfield (Mass.) Electric Company to succeed J. F. Burt, who joins the Western Massachusetts Companies. Mr. Nelson has been connected with a wholesale electrical supply house in Seattle, Wash., and for the past three years has been with the Westinghouse Electric & Manufacturing Company, Mansfield, Ohio, and Boston, Mass.

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HAROLD H. CLARK, vice-president and assistant secretary of the Pacific division of the Link-Belt Company, has retired after spending 30 years in the service of the Link-Belt Company and its subsidiaries. His early activities included a position in the drafting room, as salesman, the formation of a sales agency in Los Angeles for Link-Belt and others and the organization in that city of a Link-Belt branch office. In 1920 the west coast branch offices were organized as the Link-Belt Pacific Company, of which Mr. Clark became vice-president and treasurer. On the purchase of Meese & Gottfried Company, the coast organization became the Link-Belt Meese & Gottfried Company, which later was changed to Link-Belt Company, Pacific division. Mr. Clark was vice-president and assistant secretary of this organization, having in charge the sales and advertising activities.

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G. W. OUSLER has been appointed general sales manager of the Duquesne Light Company. Mr. Ousler entered the employ of the Philadelphia Company in 1916 in the engineering department and ten years later he was transferred to the commercial department as manager of a newly formed engineering division in charge of estimating cost and of preparing designs for substations and line extensions for customers' installations. In 1927 he was made director of sales engineering. When the sales and service department was organized in May, 1928, Mr. Ousler was made manager of sales development, and the rate department of the gas, electric and steam companies was also placed in his charge. In the spring of 1929 he was made manager of rates and retail service in charge of central and district gas and electric retail sales and service, home service and rates of the Philadelphia Company. He is a member of the Engineering Society of Western Pennsylvania, American Institute of Electrical Engineers, the utilization committee of the National Electric Light Association and in addition is president of the Electric League of Pittsburgh.

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D. C. Green Heads Public Relations Section

D. C. GREEN, who was elected chairman of the Public Relations National Section of the National Electric Light Association, as announced in the July 4 issue of the ELECTRICAL WORLD, is at the present time a vice-president of the Electric Bond & Share Company with

headquarters in New York. Mr. Green came East two years ago after a long period of service in the public utility industry in the West. He started with the Byllesby interests in San Diego and before severing his connection with that organization he had successfully filled managerial positions with its subsidiary properties in various cities in Oregon, Washington and Arkansas.

And so when, in 1923, Mr. Green was made vice-president and general manager of the Utah Power & Light Company, which is under the supervision of the Electric Bond & Share Company, he was by no means an inexperienced executive. In the course of his career in Utah he did not restrict his attention to local company affairs, but went abroad and established intimate contacts with engineering societies and associations which were of immeasurable value. The result was that when the parent company needed a progressive executive to shoulder some of the responsibilities in the home office it found what it wanted in D. C. Green.

OBITUARY

Dr. Edward G. Acheson

DR. EDWARD G. ACHESON, well-known scientist and inventor, died, of pneumonia, July 6 in New York in his seventy-sixth year. Dr. Acheson is, perhaps, chiefly known as the discoverer of carborundum, the abrasive and refractory which has benefited so many industries. Following extensive experiments in the electric furnace field, he produced the first large sample of artificial graphite, a discovery which, generally speaking, revolutionized industry and specifically resulted in a wider use of the electric furnace commercially. His work on graphite led him into the field of chemistry and he was soon occupied with lubrication problems.

Washington, Pa., was Dr. Acheson's birthplace. His schooling was interrupted because of financial reverses when he had only completed three years, but in spite of this handicap his penchant for things scientific became apparent at an early age, and at 17 he had his first United States patent to his credit. He was successively chainman in a surveying party, railroad ticket clerk, engineer, bookkeeper and iron miner before becoming assistant draftsman for Thomas A. Edison at Menlo Park in 1880. Dr. Acheson was the recipient of numerous scientific awards, including the Perkin gold medal, the highest American honor in the field of chemistry; the Rumford medal from the Academy of Arts and Sciences and the John Scott medal twice from the Franklin Institute.

Three years ago Dr. Acheson presented to the American Electrochemical Society $25,000 as a trust fund to form the basis of an award every second year of a gold medal and a prize of $1,000 for a distinguished contribution to any of the branches fostered by the American Electrochemical Society.

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EZRA M. LAWTON, some years ago connected with the electrical industry in Cincinnati, Ohio, died, July 2, at Pasadena, Calif., in his sixty-seventh year. Mr. Lawton was superintendent of construction for the Cincinnati Electric Light Companies from 1890 to 1895 and established an electrical contracting business, which he maintained until 1906, when he went to Mexico. Subsequently he entered the diplomatic service and served as Consul in Mexico, Honduras, Guatemala, Brazil and in Sydney, Australia. He carried out several special missions in the consular service. He resigned in 1929 and settled in Pasadena. Mr. Lawton was a native of Ironton, Ohio.

Financial and Statistical News

AS THE favorable influence of the moratorium on business wears off more attention is again paid to second quarter earnings, which, although fully and often accurately anticipated, have their influence on markets just as though they were actually news. It is not unexpected, therefore, that the markets have difficulty in holding the huge gains occasioned by debt cancellation discussions. Utilities, however, have receded only fractionally during the week.

——RECENT UTILITY ISSUES ARE SAID TO HAVE MET very favorable market reception, although at lowest rates on record. Naturally most of them have been placed on a long-term basis, the average for mortgage bonds recently sold being 40 years. This substantial reduction in carrying charges for several decades to come will have an important bearing on future earnings.

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Industrial Power Statistics in Preparation

IN CONNECTION WITH the biennial census of manufactures the Bureau of the Census has made it a practice to publish statistics on the power installations in various industries. This portion of the report on the census for 1929 is stated to be now in preparation and the results are expected to be available in the fall. It will show, among other things, the increase since 1927 in the horsepower of electric motors operated on purchased energy as well as the horsepower of those operated on energy generated in the establishments reporting.

The manufactures division is also stated to be rushing through a report which will show the amount and cost of each kind of fuel used in each industry and in each state. Consumption in individual large cities is to be given as to both quantity and cost. The study will cover counties and all towns of more than 10,000 population. In the smaller subdivisions, however, quantities alone will be reported. There will be totals also for industries as a whole without subdivision as to location.

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British Output Grows 80 per Cent in Eight Years

OFFICIAL RETURNS TO THE British Electricity Commission show that 867,000,000 kw.-hr. was generated by authorized undertakers in the United Kingdom during April, 1931, as compared with the finally revised figure of 849,000,000 kw.-hr. in the corresponding month of 1930, or an increase of 2.1 per cent. During the first four months of 1931, up to the end of April, the total was 4,052,000,000 kw.-hr., as compared with the finally revised figure of 3,880,000,000 kw.-hr. for the corresponding period of 1930, representing an increase of 4.4 per cent.

Figures on a quarterly basis for the years 1924 to 1927 have also been recently prepared by the commission and are embodied in the table herewith, together with a summary of the figures already published for the years 1928 to 1930. The table gives the approximate total generated by authorized undertakers in millions of kilowatt-hours.

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year Total
1924	1,664	1,347	1,331	1,752	6,094
1925	1,798	1,430	1,453	1,984	6,665
1926	1,992	1,459	1,458	2,131	7,040
1927	2,200	1,760	1,814	2,460	8,234
1928	2,472	1,994	1,929	2,678	9,073
1929	2,844	2,254	2,193	3,003	10,294
1930	3,031	2,390	2,341	3,152	10,914
1931	3,185	.....	.....	.....	.....

The output in every quarter showed an increase over the output in the corresponding quarter of the preceding year, even in 1930. The output of stations belonging to companies other than authorized undertakers, leased to or operated by the latter and utilized for the purpose of their undertakings, has been included in these statistics.

During May 802,000,000 kw.-hr. was generated as compared with the finally revised figure of 832,000,000 kw.-hr. in May, 1930, or a decrease of 3.6 per cent. During the first five months of 1931 up to the end of May the corresponding total was 4,854,000,000 kw.-hr., as compared with the finally revised figure of 4,712,000,000 kw.-hr. for 1930, representing an increase of 3 per cent.

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Bond Market Rise Precedes General Business Upturn

WHILE the trend of bond prices has been generally upward since early June, various factors have recently induced irregularity. Many banks have sold some of their bond holdings to make a more liquid showing in annual statements. There has also been corporate selling to establish losses for tax purposes. Then the uncertainty with regard to the proposed international debt moratorium has caused hesitancy in buying. Prices, however, remain close to the highs since 1928, supported in part by reinvestment of the millions distributed in mid-year dividends. The Dow-Jones average of ten utilities is now 97.67, against 93.04 a year ago.

Relation to business cycle

Recent strength in the bond market has been shared by second-grade obligations, reflecting a general feeling of increasing confidence, security being the feature of question in these issues.

How the bond market trend relates to the general business trend has been interestingly reviewed by the National City Bank of New York. From its study appears the following:

It is sometimes argued that the investor who purchases high-grade bonds on the current low yield basis runs the risk of having them decline in price as soon as business begins to recover and interest rates to firm up. In so far as past records may be a guide, however, they indicate that a considerable period usually elapses after the upward turn of busines before interest rates rise sufficiently to affect prices of prime bonds, which tend to be maintained permanently at a high level, save during periods when credit becomes abnormally tight. Generally speaking, the downward turn has not come in the past until about the time the business indexes crossed normal on the way up. The record seems to show that narrowing of the spread between prime and secondary bonds during business recovery takes place not because the former decline but because the latter advance. . . .

Prices of the highest grade bonds reached their low in May, 1920, and advanced until August, 1922. The index of business activity stood at peak in June, 1920, declined to bottom in March, 1921, and recovered

to calculated normal by November, 1922. The advance in the bond market, therefore, began ten months before business turned upward and continued seventeen months afterward. When the break in business occurred, short-term money rates were high and a widespread condition of frozen credits existed, which delayed the natural easing of credit. Once under way, however, the decline in interest rates continued for two years, with no firming up until recovery had carried the business index nearly back to normal. Underlying causes for the rise in the high-grade bond market were the same during this period as they are today, namely, a downtrend in interest rates, an increased supply of bank funds resulting from reduction of loans and a preference among bond investors for only gilt-edge issues.

The duration of the rise in bond prices after the turn in business as shown by the two long-term indexes may be summarized as follows:

Business Low Point	Bond Price High Point	Months Difference
Feb., 1885	July, 1886	17
June, 1894	Aug., 1895	14
Nov., 1896	June, 1899	31
March, 1908	Feb., 1909	11
March, 1921	Aug., 1922	17

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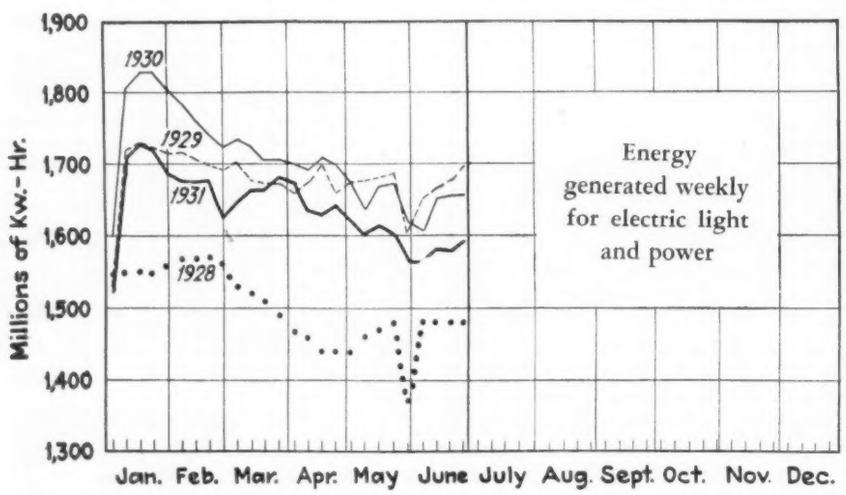
Weekly Energy Output

OUTPUT OF ELECTRIC light and power companies in the United States, as estimated by the statistical research department of the National Electric Light Association, is shown in the accompanying chart. For recent weeks and correspondingly in preceding years the energy generated was:

	Millions of Kw.-Hr.			
Week Ended	1931	1930	1929	1928
June 6	1,562	1,608	1,653	1,480
June 13	1,581	1,663	1,675	1,480
June 20	1,579	1,656	1,678	1,480
June 27	1,593	1,657	1,698	1,480
July 4	1,576	1,621	1,611	1,366

In successive weeks beginning with that ended June 6 the output this year has been below that of the corresponding period in 1930 by 2.9, 4.9, 4.6, 3.9 and 2.8 per cent.



Cities Service Stock Barred in Kansas

APPROVAL for the sale in the State of Kansas of Cities Service common stock was withdrawn this week on instructions of Governor Harry Woodring to the State Banking Department. The announcement was met by a sharp reply from Henry L. Doherty, president of the company, who also communicated with Postmaster-General Brown urging that the Kansas City *Star*, which publication Mr. Doherty blamed for instigating the action, be barred from the mails. Copies of his wire to Governor Woodring were sent to the Kansas City Chamber of Commerce, the American Newspaper Publishers' Association, the United States Chamber of Commerce, the National Better Business Bureau, etc.

Mr. Doherty also wired Secretary of Commerce Lamont pointing out that Governor Woodring had threatened to throw certain Cities Service subsidiaries into receivership. He referred to the hundred-million dollar gas pipe line project on which 10,000 employees are engaged. He charged that the Kansas City *Star* was seeking to impair the credit and cripple the operations of the company and that all this would add to the business depression and unemployment.

Governor Woodring had asked the company that a voluntary reduction of 10 cents per 1,000 cu.ft. be made in the rates charged for gas to local distributing companies from the existing 40-cent rate. A conference was held between Mr. Doherty and Governor Woodring in Washington and a brief delay was asked by the company. Without giving the company further opportunity for discussing the matter of adjusting these rates, it is charged, the Governor called for an investigation of the company's rates on August 18. The same day, July 3, the Blue Sky Commission of Kansas barred certain of the company's securities from sale within the state on the ground that "prior liens make the common and other stocks worthless." A temporary injunction, however, has been secured against the order.

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Billion in Canadian Power

CAPITAL INVESTMENT in the electric light and power industry in Canada passed the billion-dollar mark in 1929. According to the Dominion Bureau of Statistics the investment of $1,055,731,532, as at December 31, was by far the largest investment in any single manufacturing industry, the second industry being the pulp and paper, with $644,733,806, and the third, sawmills, with $181,586,699.

The increase during the year of $98,811,929 included only expenditures by stations operating on December 31. The only industry reporting to the bureau to show a larger investment was steam railways with $3,153,350,558 and an increase during 1929 of $136,212,758.

The output for 1929, 17,962,515,000 kw-hr., was an increase over the 1928 output of 10 per cent, as against yearly increases of 12, 20 and 20 per cent, respectively, in 1928, 1927 and 1926. Compared with 1922 the capital investment increased 186 per cent, the output 266 per cent.

The large increase in use of electricity for power and lighting and also the increasing use of off-peak power from water-power plants have increased the quantity of useful power per unit of capacity of equipment so that in 1929 the

Central Electric Stations, Canada

	1929	1928
Power plants, number	585	601
Capital	$1,055,731,532	$956,919,603
Revenue from ultimate consumers	122,883,446	112,326,819
Salaries and wages	24,831,821	24,087,420
Taxes	4,968,763	4,597,399
Employees, number	16,164	15,855
Pole line miles	42,913	37,333
For transmission	17,069	14,372
For distribution	25,844	22,961
Customers, number	1,555,883	1,464,005
Domestic service	1,292,481	1,207,457
Commercial light[1]	233,854	215,728
Power[2]	28,001	40,820
Street lighting	1,547	.....
Electric energy generated, kw.-hr.	17,962,515,000	16,337,804,000
Prime movers, main plant, hp.	4,925,555[3]	4,627,667
Waterwheels and turbines	4,718,927	4,445,531
Steam reciprocating engines	26,103	29,206
Steam turbines	156,873	131,295
Internal combustion engines	23,652	21,635
Generating equipment	4,048,019	3,764,331

[1]Commercial light and power loads of 50 kw. and under for 1929. Not comparable with 1928.
[2]Commercial light and power loads of over 50 kw. for 1929. Not comparable with 1928.
[3]5,097,443 including equipment in auxiliary plants.

ratio of output to maximum of rated capacity was 50 per cent, as against 42 per cent in 1922. A few large systems have ratios of 60 to 72 per cent. In computing this ratio, allowance was made for generators installed or removed during the year. In the United States, according to the report for 1927, the ratio was only 33 per cent, making no allowance for equipment in place only part of the year. The nature of the industries served accounts for this difference to some extent.

The total revenue, excluding payments for power interchanged between stations, amounted to $122,883,446. More than one-quarter of the revenue, or $33,627,863, was received from domestic service.

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NEWS BRIEFS

The Railroad Commission of California has granted an extension of time to the Pacific Gas & Electric Company in which to exchange shares of its preferred stock for preferred stocks of Great Western Power Company of California and Feather River Power Company until September 30, 1931.

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Two holding companies to deal in electricity, gas, etc., have been chartered by the Secretary of State of New York, each with the same directors and subscribers and same amount of capital, $10,000. The two companies are System Developments, Inc., and Eastern Developments, Inc., both of New York City. Frederick Shoffield, Frederick A. O. Schwarz and Edward R. Wardwell are directors and subscribers.

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Massachusetts Department of Public Utilities has approved the issuance by the Edison Electric Illuminating Company of Brockton at $40 a share of 19,368 additional shares of $25 par capital stock.

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Georgia Hydro-Electric Company, part of the Commonwealth & Southern System, has called for redemption at 105 and interest August 1, 1931, its outstanding first mortgage 6½ per cent gold bonds due February 1, 1945, which are outstanding in the amount of $458,400.

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Directors of the Holyoke (Mass.) Water Power Company have declared an extra dividend of $1.

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Preferred and common stock holders of Jersey Central Power & Light Company have authorized an increase in the preferred shares of the company from $20,000,000 to $40,000,000 ($100 par value) and an increase of from 1,000,000 to 2,000,000 common shares having no par value. This action was required in order to permit the issuance of additional shares of preferred and common stocks by Jersey Central Power & Light Company in connection with the acquisition by that company of all of the assets of Eastern New Jersey Power Company.

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Growth Possibilities Great in Rural Districts

UTILITIES SERVING SMALL TOWNS and rural districts show growth possibilities as great as or greater than metropolitan systems. This is the conclusion reached by Martin J. Insull, president Middle West Utilities Company, after a study of companies serving the two types of territory. Mr. Insull said in part:

In a typical group of companies serving big-city and small-town territories the metropolitan companies show a decline in output of 3.8 per cent for the first twenty weeks of 1931 from the corresponding period of 1930. The companies serving non-metropolitan territories, however, show an increase of 1.3 per cent in output. The national average for the same period was 4 per cent under that of the previous year.

This is possibly only partially due to the greater stability of business in the less congested territories, although there is evidence that the small communities have shown a greater resistance to depression. It is more likely due to the less saturated and more fertile market in the small towns. This is true of both industrial and domestic consumption.

In connection with industrial consumption in non-metropolitan territories, the significant factor is the tendency of manufacturing to avoid high costs of congestion by locating plants in smaller communities.

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CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

Operating Companies

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
California Oregon Power (Year ended April 30)					
Gross earnings	$3,966,017	$3,560,338	11.4	..	..
Net earnings	2,153,601	2,122,448	1.5	..	..
Consumers Power (Year ended May 31)					
Gross earnings	31,869,197	33,293,699	— 4.3	43	48
Net earnings	18,076,767	17,279,724	4.6	..	..
Detroit Edison (Year ended May 31)					
Gross earnings	51,502,019	56,142,541	— 8.2	67	67
Net earnings	17,089,609	18,529,590	— 7.7	..	..
Louisville Gas & Electric (Year ended April 30)					
Gross earnings	10,728,525	10,387,368	3.3	..	..
Net earnings	5,676,951	5,356,008	6.0	..	..
Mountain States Power (Year ended April 30)					
Gross earnings	3,447,571	3,429,512	0.5	..	..
Net earnings	1,193,311	1,320,174	— 9.5	..	..
Nevada-California Electric & subs. (Year ended May 31)					
Gross earnings	5,737,585	5,770,409	— 5.7	48	49
Net earnings	2,985,798	2,945,219	1.3	..	..
Northern States Power (Year ended April 30)					
Gross earnings	33,511,765	32,964,705	1.7	..	..
Net earnings	16,815,945	16,755,458	0.4	..	..
Ohio Edison (Year ended May 31)					
Gross earnings	18,961,213	19,468,664	— 2.6	38	42
Net earnings	11,647,153	11,313,792	2.9	..	..
Oklahoma Gas & Electric (Year ended April 30)					
Gross earnings	13,423,440	14,508,659	— 7.5	..	..
Net earnings	6,130,767	6,762,218	— 9.3	..	..
Puget Sound Power & Light (Year ended May 31)					
Gross earnings	16,594,740	16,861,462	— 1.6	..	..
Net earnings	7,230,839	7,144,927	1.2	..	..
San Diego Consolidated Gas & Electric (Year ended April 30)					
Gross earnings	7,390,433	7,203,460	2.5	..	..
Net earnings	3,788,771	3,402,828	11.3	..	..

Operating Companies

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
Southern Colorado Power (Year ended April 30)					
Gross earnings	$2,216,376	$2,283,234	— 2.9	..	..
Net earnings	1,025,804	1,067,313	— 3.9	..	..
Wisconsin Public Service (Year ended April 30)					
Gross earnings	5,565,455	5,573,753	— 0.1	..	..
Net earnings	2,284,583	2,397,694	— 4.7	..	..

Holding Companies

American Power & Light & subs. (Year ended March 31)					
Gross earnings	86,122,700	88,406,792	— 1.4	..	..
Net earnings	44,748,548	45,590,856	— 2.0	..	..
Cities Service (Year ended May 31)					
Gross earnings	51,707,481	54,464,046	— 5.0	..	..
Net earnings	49,014,139	52,804,197	— 7.2	..	..
Commonwealth & Southern & subs. (Year ended May 31)					
Gross earnings	136,381,132	147,247,920	— 7.4	48	49
Net earnings	71,087,118	75,295,319	— 5.6	..	..
Electric Power & Light & subs. (Year ended March 31)					
Gross earnings	80,866,305	61,204,469	32.0	49	50
Net earnings	41,210,465	30,230,753	36.1	..	..
National Power & Light & subs. (Year ended March 31)					
Gross earnings	79,388,219	81,109,278	— 2.1	55	55
Net earnings	35,891,404	36,464,229	— 1.6	..	..
Philadelphia Company (Year ended April 30)					
Gross earnings	60,199,454	63,544,721	— 5.2	..	..
Net earnings	29,925,785	31,367,007	— 4.6	..	..
Public Service Corp. of New Jersey & subs. (Year ended May 31)					
Gross earnings	139,276,209	138,623,441	4.7	67	69
Net earnings	44,887,493	42,603,477	5.3	..	..
Standard Gas & Electric & subs. (Year ended April 30)					
Gross earnings	151,630,819	155,357,799	— 2.4	..	..
Net earnings	73,159,778	74,850,343	— 2.3	..	..

Business News and Markets

Editors Find Business Thoroughly Liquidated

BUSINESS IN THE United States has rid itself of all unnecessary overhead burdens accumulated during the prosperity period. Thoroughly liquidated, it is now extremely sensitive to all influences and ready to respond to the slightest stimulus. This is the consensus of 155 editors of technical, trade, service and professional business papers—members of the National Conference of Business Paper Editors and the Associated Business Papers as expressed in their eighth semi-annual survey of the business outlook, just completed.

While they do not find that the upturn of business has been reached generally, these editors do, in certain fields, report that signs of improvement have already been observed. The industries in which this has occurred included the automotive equipment and parts section of the automobile industry, chemicals, machine tools, electric power production, textiles, commercial bakeries, furniture manufacturing, construction, meat packing, shoe retailing, radio broadcasting.

The editors report that aggressive merchandising in which manufacturers and retailers co-operate to develop goods that will sell under present-day conditions has characterized businees for the six months just closed. Further, they state that, in the main, inventories of raw materials and finished products are now so depleted that replacement buying cannot be much longer postponed.

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Automatic Refrigerator Standard Test Code

WORK ON THE PREPARATION of a standard test code for automatic refrigerators is being undertaken by the subcommittee on tests of the sectional committee on specifications for refrigerators (B38) under the procedure of the American Standards Association. The subcommittee has recently been reorganized for this purpose following its completion of a draft of a standard test code for ice refrigerators.

The test for automatic refrigerators will cover the following five principal elements of performance:

Ambient temperature under standardized conditions.
Internal temperatures.
Power input (electricity, gas or other fuel, and water).
Proportion of time in operation.
Number of cycles of operation in a unit of time.

Charles E. Roe, Electrical Testing Laboratories, New York City, is chairman of the sectional committee, and of the subcommittee which will prepare the draft.

The American Society of Refrigerating Engineers and the Bureau of Home Economics of the U. S. Department of Agriculture are joint sponsors.

Allis-Chalmers Reports Unfilled Orders

Unfilled orders of the Allis-Chalmers Manufacturing Company on July 1 amounted to $9,051,000, against $9,776,000 on June 1. On January 1, last, order books held $13,012,000 of business. As of July 1, 1930, the unfilled orders were $17,926,000. It is understood that inquiries have increased recently.

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Motor Distribution Problems Largely Ironed Out

URGING upon the motor dealer the necessity of a definite signed statement by the manufacturer with whom he has an agreement setting forth the attitude and policies of the latter, Louis Kalischer, chairman motor section, Association of Electragists International, recently presented a résumé of motor sales experience, to date, to presidents and secretaries of all chapters. The résumé covers leading problems and matters of policy with which motor specialists are concerned.

The ease with which a franchise to sell motors was secured during the war was followed by sales resistance in the early twenties. This led to many inequalities and questionable practices in distribution, which led to a series of attempts to define the function of the various agencies, including the contractor.

Then in 1927 the national motor section committee was formed to study policies and attack abuses. The "Fresno" plan was adopted by the California state convention of Electragists in 1928 and many other plans were adopted.

Out of several of these plans there evolved the "Suggested Motor Distribution Policies," embodying seven points. A joint committee of motor specialists and N.E.M.A. met several times to unravel difficult phases of the problem.

In view of legal limitation on trade agreement discussions the group could only strive for "the simple recognition of the proper sphere of sales activities in the distribution of motors and motor accessories, trying to secure a fair field and a better representation for both the manufacturer and the reseller." Changes actually brought about covered such matters as service shops, discount on fractional-horsepower motors, motor repair parts, classification of motor specialists, policies of machinery manufacturers, motor brokers, stator exchange policies.

Of the seven points in the suggested motor distribution policies, only two remain for further research. They concern commission on the sale of motors above 200 hp. and compensation of the motor specialist who installs the wiring where a motor has been sold direct to the customers by the manufacturer.

Mr. Kalischer points out that much has been accomplished, but that a great deal of missionary work is needed to iron out the problems in the way of assuring a fair opportunity for the motor specialist to secure business at a reasonable profit.

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Canadian Industry Largely Electrified

ONLY ONE MAJOR INDUSTRY in the Dominion is less than 50 per cent electrified, according to a survey just completed by the Royal Bank of Canada. Three industries are 100 per cent electrified and five are 90 per cent electrified, the study shows.

All power used in the automobile, clay products and rubber goods industries is electrical. Sugar refining, printing and publishing, and plants manufacturing hardware and tools, brass and copper products, coke and gas products, and electric apparatus and supplies have 90 per cent electric power installations. In the long list of industries mentioned

in the table of power equipment published by the Dominion Bureau of Statistics the manufacture of feed and grist is the only one which utilizes less than 50 per cent of electric energy. Seventy per cent of all the energy used throughout the mining industry of the country, including coal, metals and petroleum, is electrical.

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Anaconda Gets Copper Conductor Order

TRANSMISSION ENGINEERS WILL be interested in the recent order for Anaconda hollow copper conductor for the Pennsylvania Railroad New York to Washington electrification. This conductor of 0.73-in. over-all diameter, composed of one layer of fourteen hard-drawn copper wires, cabled over the standard Anaconda twisted I-beam core, will be used for the 132,000-volt transmission line on this electrification. The main reason for specifying this extra-large-diameter, light-weight conductor was to avoid corona discharge and the accompanying static disturbances in the radio receiving sets of residents along this densely populated right-of-way.

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Westinghouse to Manufacture Washing Machines

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has extended its activities in the field of domestic electrical appliances in offering a new line of washing machines to be marketed under the Westinghouse trademark. At present the Westinghouse line of household appliances includes electric refrigerators, ranges, irons, fans and many other necessities for the comfort in the home.

According to M. C. Morrow, Westinghouse merchandising sales manager, four models of washing machines will be marketed, two wringer models and two centrifugal driers, double tub models. They will be sold in medium and de luxe price ranges.

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Ohio Brass Receives Insulator Order

THE THIRD ORDER for insulators and transmission line hardware to be used in connection with the extensive electrification projects of the Egyptian government, now nearing completion in the Nile Valley, has just been received by the Ohio Brass Company. This most recent order for suspension insulators and hardware fittings amounts to approximately $79,000 and brings the total volume of orders received during the past twelve months for this project to $250,000.

TRADE BRIEFS

L. W. Mercer, vice-president and general manager Square D Company, Detroit, Mich., has announced the establishment of the power filter division of the Square D Company, with offices and works at Detroit.

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International Derrick & Equipment Company and the Stacey Engineering Company have merged to form the International Stacey Corporation, with the home office located in Columbus, Ohio.

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Charles Croft has been appointed direct representative of the Railway & Industrial Engineering Company in Los Angeles, at 110 N. Alameda Street.

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Blaw-Knox Company has acquired the exclusive sales and manufacturing rights of the "Ateco" line of earth-moving machinery from the American Tractor & Equipment Company of Oakland, Calif., for the United States east of the Rocky Mountains and for all other countries.

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INDUSTRIAL ACCIDENT STATISTICS. The National Safety Council, Inc., 20 N. Wacker Dr., Chicago, Ill., has published under the above title the 1931 edition of injury records in 28 American industries during 1930 and previous years. In it is condensed the accident experience of 4,200 industrial establishments, representing 5,000,000 man-hours of work.

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Herbert B. Bassett has been promoted from assistant sales manager of the Acme Wire Company to the position of sales manager, replacing E. L. Hartpence, who, however, remains a director.

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The James R. Kearney Corporation announces that William H. Teegardin is associated with its district representative, Charles Wenner, in Ohio.

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W. J. Batchler has been appointed representative of the Trumbull Electric Manufacturing Company in the Maryland-Virginia-North Carolina territory, including the District of Columbia. His headquarters will be at Baltimore.

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New York Metal Prices

	July 1, 1931 Cents per Pound	July 8, 1931 Cents per Pound
Copper, electrolytic	8¼–8⅜	8.
Lead, Am. S. & R. price	4.40	4.40
Antimony	7	6.95
Nickel, ingot	35	35
Zinc, spot	4.25	4.25
Tin, Straits	25.⅛	25.30
Aluminum, 99 per cent.	23.30	23.30

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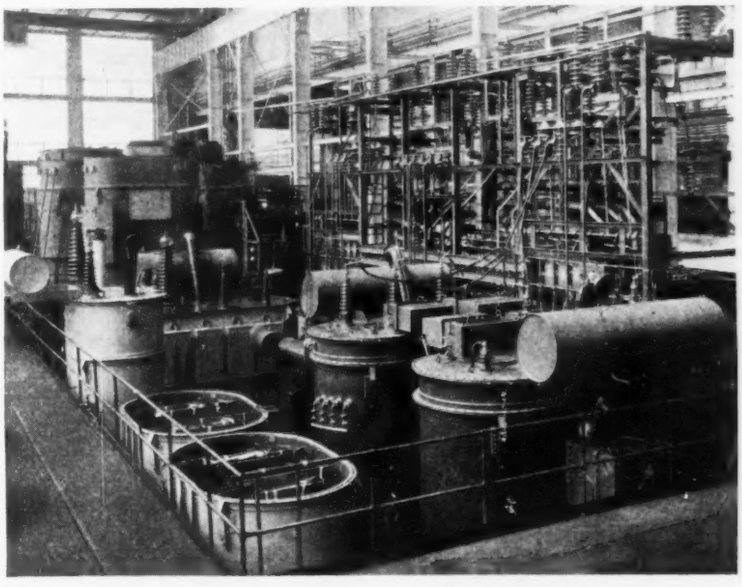
ACID TEST FOR TRANSFORMERS



Transformers undergoing factory tests in the "big pit" at the Pittsfield Works of the General Electric Company. At the right and extending to the background are two berths housing control equipment for power distribution from two 12,000-kva. generators and two large 20,000-kva. water-cooled transformers in the foreground equipped with conservator oil tanks and load ratio control undergoing tests for copper losses.

Market Conditions

ELECTRICAL equipment business appears to have slowed down in almost all sections of the country during the first week of the second half year. Prospects are brighter, with inquiries increasing, in the Eastern district, but actual orders are slow in materializing.

——THE PACIFIC COAST REPORTS THE PAST WEEK THE SMALLEST of the year so far. Business is below normal except in isolated spots.

——NEW ENGLAND HAS BEEN ONE OF THE MOST ACTIVE SECTIONS, with water heaters a feature.

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PACIFIC COAST

—CONTRACTORS REPORT THEIR JOBS *and crews as far below normal, but nearly all firms have some work, and in a few isolated cases are running crews of 20 to 40. Railroad business is featured by the award of the Southern Pacific lamp contract for two years to General Electric.*

—STATE BUSINESS IS *fairly heavy, due largely to the desire of numerous departments to utilize their budgets for the fiscal year ended July 1. This business covers staples and is well distributed throughout the state.*

Nevada business, through the influx of tourists and visitors, workers and homesteaders to the neighborhood of Hoover Dam, is excellent. Numerous small school jobs are reported in the Bay area. Power company business is comparatively poor, new construction and work being at a minimum and line material orders being of small size and largely for maintenance. Very few orders of even average size and interest have been placed this past week, which ranks among the worst of the year, but they include one carload each of Westinghouse ranges and refrigerators for a Seattle wholesaler, additional auxiliary motors for a San Francisco passenger ship, valued at $16,000 and a $1,500 meter house equipment for a transpacific communication company.

Sales reported last week by Seattle jobbers included 30 distribution transformers, from 20 kva. down, to a local central station and three of 50 kva. to an irrigation district, fifteen motors from 30 hp. down to irrigation districts and dealers, one 200 hp. and two 150-hp. machines to a pulp and paper mill, 45 from 50 hp. down to mills, woodworking plants and small industrials, seven from 15 hp. down to a fruit and vegetable cannery, 25 machines from 50 hp. down to scattered industrials and dealers and approximately $10,000 worth of lighting materials for the State Capitol grounds, including potheads, standards, conduit and cable. The Seattle lighting department is taking bids for approximately $2,500 worth of armature coils, and has awarded contracts for about $1,000 worth of 11-in. disk strain insulators and for a 24-kw. motor-generator set. An extension of the Seattle city light distribution system, at an estimated cost of $280,000, was voted unanimously by the Council.

CONSTRUCTION PROJECTS

San Jose Cement Company, Ltd., San Francisco, Calif., has plans completed at office of Hunt, Mirk & Company, San Francisco, engineers, for cement mill near San Jose, to cost over $2,000,000; project will include a power station. State Teachers College, Santa Barbara, Cailf., has plans for a science building to cost over $100,000, with equipment. Owens-Illinois Glass Company, Toledo, Ohio, has secured permission from city of Alameda, Calif., for a new plant, including power house, to cost more than $1,000,000. Lewiston Grain Growers, Inc., Lewiston, Idaho, is considering a grain elevator to cost close to $90,000. Ohio-Keating Gold Mining Corporation, Radersburg, Mont., C. L. Hewitt, manager, contemplates a new mill at mining properties, reported to cost close to $80,000.

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SOUTHEAST

—THE TONE OF BUSINESS *in the Southeast seems to be improving, though it is hard to put one's finger on anything in particular. A fairly well-sustained volume of electrical business is the result of a large number of small orders, no outstanding individual orders being reported.*

A Georgia company's distribution and current transformer orders last week aggregated $13,055, while its pole line hardware and creosoted pine pole orders totaled $9,200. Another company ordered $2,600 worth of jointing material last week. An East Coast of Florida company ordered a car of bare and weatherproof copper wire. The U. S. Penitentiary ordered last week $3,000 worth of miscellaneous wiring supplies, $1,200 of fans and $1,000 of lighting fixtures. It expects to place next week an order for switchboard equipment amounting to $10,000. A Georgia textile mill purchased wiring supplies amounting to $4,000 and a $6,000 order for similar material is expected to be placed next week by the government at Fort Benning, Georgia.

CONSTRUCTION PROJECTS

Constructing Quartermaster, Fort Monroe, Va., will receive bids until July 28 for a radio building at Langley Field, Va., as per specifications on file. Appalachian Electric Power Company, Bluefield, W. Va., plans transmission line over Kanawha River from Buffalo to Pliny, Va. Norfolk, Va., contemplates wharves and warehouse terminal on waterfront to cost over $200,000. Maryville, Tenn., plans ornamental lighting system. Florida Lime Company, Ocala, Fla., plans new hydrate lime-manufacturing plant, reported to cost over $80,000. Wofford Oil Company, Mobile, Ala., contemplates oil storage and distributing plant, near Montgomery, to cost $100,000.

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MIDDLE WEST

—VERY LITTLE, IF ANY, *change in general business is observed this week in the Middle West section. For the most part business appears to be marking time.*

—UNDERLYING *sentiment is fundamentally cheerful, but the needed impetus to start business moving is lacking. Major activities are in relatively the same position as last week with no immediate prospects for much improvement.*

Production of electrical energy continues to gain from week to week in the Chicago area, averaging about 1½ per cent below the similar period last year. Some of the interesting orders placed this week include speed selector switches complete with appurtenances to cost $13,000, six 4,000-amp., 15-kv. outdoor type disconnecting switches, three carloads of asbestos tape, one carload of fiber conduit and several construction orders aggregating $50,000.

CONSTRUCTION PROJECTS

Gresham, Wis., will receive bids until July 20 for a municipal hydro-electric power plant, including one 125-kva. waterwheel-generator unit and one 219-kva. generator of similar type (only one machine to be installed at present time) and complete auxiliary equipment. Calumet & Hecla Consolidated Mining Company, Calumet, Mich., plans research laboratory. Detroit Public Lighting Commission, Detroit, Mich., has plans for a power substation to cost $50,000. American Airways, Inc., Robertson, Mo., has plans for hangar at airport at Chicago, Ill., to cost $100,000. Richmond, Ind., proposes to reject bids recently received for equipment for expansion and improvement program at municipal power plant to cost $850,000 and will soon ask new bids. Contracting Officer, Air Corps, United States Army, Wright Field, Dayton, Ohio, will receive

bids until July 20 for 200,000 electrodes, 400,000 gaskets, etc. (Circular 28). Kettle River, Minn., will discontinue municipal electric generating plant and is offering property for sale. Minneapolis, Minn., will soon take bids for a vocational training school to cost $400,000. Union Terminal Warehouse Company, Lincoln, Neb., plans multi-story terminal building to cost $300,000, with equipment.

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EASTERN

—A HOLIDAY WEEK-END, *coupled with a session of torrid weather, has had the natural effect of making a slow market still slower, and the Eastern district records little new worthwhile business. Prospects continue encouraging, but there is marked hesitancy on the part of central stations and industrial interests in placing commitments.*

—WITH THE TURN *of the summer season, inquiries show a tendency to slacken and manufacturers are turning to prospective accounts of several weeks ago in an effort to develop renewed attention. Railway electrification scores the best totals of the week and sizable business continues from that quarter. Marine account, likewise, has a substantial commitment to its credit.*

Pennsylvania Railroad Company is negotiating with the Arundel Corporation, Baltimore, Md., for installation of underground conduits, erection of steel poles for overhead lines and other construction work in connection with its electrification program between Baltimore and Washington, contract reported to total about $2,000,000. The railroad has placed an order with a New York manufacturer for transformers and switching equipment for substation service on the New Jersey section of the program between Trenton and Manhattan Transfer, approximating $300,000. Westinghouse Electric & Manufacturing Company will co-operate with the Baldwin Locomotive Works for the construction of the 54 electric locomotives for which contract was recently received from the railroad.

An electrical equipment manufacturer in New Jersey reports more active inquiries from the iron and steel industry, and some sizable business is appearing from that account. Westinghouse Electric & Manufacturing Company has secured a contract for a battery of fifteen transformers for installation by an Indiana central station, totaling about $70,000; it will also furnish a turbogenerator unit for a municipal power station in Missouri, the award for boiler and superheater units being placed with the Union Iron Works; Combustion Engineering Corporation, New York, will supply the condenser. Bidding for government requirements continues active and highly competitive.

The Westinghouse company has taken a contract for furnishing electrical equipment for a new Diesel electric tug for the United States Public Health Service.

CONSTRUCTION PROJECTS

Port of New York Authority, New York, will receive bids until July 20 for electrical equipment and installation on new bridge over the Kill von Kull, between Port Richmond, S. I., and Bayonne, N. J., as per plans and specifications on file. Kildun Mining Corporation, New York, plans power plant at properties at Nathula, Mexico, in connection with an expansion and improvement program to cost over $300,000. Sinclair Oil & Refining Company, New York, contemplates oil refining plant at Longview, Tex., to cost over $200,000. Steuben Holding Company, Newark, N. J., has approved plans for a public market building to cost $200,000, including refrigerating and other machinery. Valley Forge Military Academy, Valley Forge, Pa., plans science building to cost $200,000. Diamond State Telephone Company, Wilmington, Del., plans installation of aerial cable lines to cost $180,000. General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until July 23 for knife switches, annunciators, electric drills, and other electrical and mechanical equipment (Panama Schedule 2670). Potomac Electric Power Company, Washington, D. C., contemplates power plant reported to cost over $2,000,000.

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SOUTHWEST

—THE GENERAL TONE *of business in electrical lines is slightly better. While most of the large utilities are showing a disposition to hold back on breaking into their budgets, the smaller power companies are sending in some orders for line construction material. Industrials are still maintaining the fair demand for stock sizes of apparatus.*

The following contracts were reported closed the past week: One for two 10,000-kva. transformers for one of the local power companies, amounting to $40,000; another covering electrical equipment for two gas-electric cars for one of the large railway systems, costing $30,000; electric heating units for stereotype melting furnaces with temperature control to equip newspaper plant, amounting to $6,000, and a miscellaneous lot of motors for the same plant amounting to $4,000.

CONSTRUCTION PROJECTS

Star Chronicle Publishing Company, St. Louis, Mo., has plans for a newspaper printing and publishing plant to cost more than $600,000. Union Electric Light & Power Company, St. Louis, Mo., has plans for a three-story office and operating building addition, reported to cost about $100,000. State Board of Affairs, Oklahoma City, Okla., has plans for an industrial building at Oklahoma State School for Deaf, Sulphur, Okla., to cost $100,000. Danciger Oil & Refining Company, Fort Worth, Tex., contemplates oil refining plant near Longview, Tex., to cost over $200,000. Dallas Power & Light Company, Dallas, Tex., plans extensions in ornamental lighting system in city, including North Lamar Street.

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NEW ENGLAND

—THE NEW ENGLAND *electrical equipment and supply market reflects an improved tone, accompanied by widely diversified orders and considerable activity in proposals.*

—*Central-station line supplies are moving more freely and four carloads of poles have been sold to the northern district. Distribution transformers are selling more actively and interest is increasing in power transformers.*

Northern Vermont bought a 3,000-kva,. three-phase transformer and bids are out for two 2,000-kva. units. A 150-kva. network transformer appears in recent sales and another of the same size is about to be purchased. Utility inquiries for steam turbines are practically dead for the moment, but industrial steam turbines are moving actively. Improvement in the woolen industry appears in motor sales, paper machinery motor drives are showing more life and general purpose motor sales are well maintained in scattered orders of considerable volume.

New England motor sales appear to be running ahead of the rest of the country. Heating apparatus is very active this week, representative recent sales including 39 kw. for a farm restaurant, 13 kw. for an automobile inn and two automatic electric welders. Two electric stereotype propositions for newspapers are under consideration this week. Water-heater sales gain steadily and in Maine one company sold 42 in the past 26 days, together with 200 electric ranges and 162 refrigerators. In Boston Edison territory 55 per cent of the 1931 electric refrigerator quota of 15,000 outfits was sold in the first five months of this year. Electrical underground construction is to be built at Woburn, Mass., and the Boston Navy Yard has bought a 3,000-lb. crane truck and a 3-ton truck, both of the industrial type. A northern company is about to buy a 150-kva. synchronous condenser.

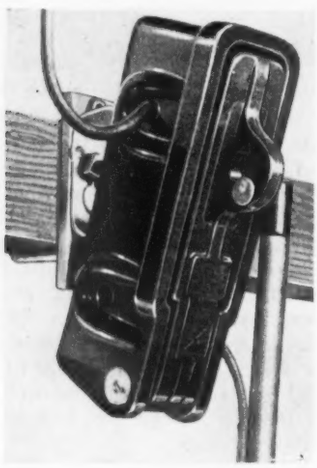
CONSTRUCTION PROJECTS

Boston Elevated Railway Company, Boston, Mass., has filed plans for extensions and improvements in power plant to cost about $70,000. Constructing Quartermaster, Camp Devens, Mass., will receive bids until July 29 for installation of an electric distribution system, as per plans on file. Standard Oil Company of New York has plans for a bulk oil storage plant.

New Equipment Available

High Interrupting Capacity Cutout

A NEWLY DESIGNED CUTOUT, said to be positive and dependable during either overload or short circuit, since its operation is independent of the amount of current blowing the fuse, and since it has exceptionally high current-interrupting capacity, is announced by Schweitzer & Conrad, Inc. Its capacity is 7,000 amp. at 2,300/4,000 volts or 4,500 amp. at 6,600 volts. It is designated type "EB Ejector Cutout."



When the fuse of the cutout is blown, whether from overload or short circuit, the arc is immediately ruptured by the instant contraction of the coil spring which widely separates the terminals and forms a definite gap over which the circuit will not re-establish. This arc-interrupting feature is assisted by the barrier effect of a cork which tightly incloses the element and assists in snuffing out the arc at its inception. Short circuits are cleared in ½ cycle or less after the fuse element is blown.

The fusible section of the element is small and the amount of metal vaporized is therefore small. Excessive explosive action is avoided and short circuits are interrupted with a minimum of disturbance, it is claimed.

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A RELAY TERMINAL BLOCK built of laminated canvas "Spauldite" (bakelite) has been placed on the market by C. D. LaMoree, Los Angeles. The block is wider than usual and sufficient room is provided between terminal chambers to permit the use of wire as large as No. 8. Binding head screws are used, eliminating the necessity of washers. All metal parts are cadmium plated. The block is made in four, eight and twelve terminal sizes.

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Micro-Focusing Floodlight Projector

A LINE OF PROJECTORS to meet floodlighting problems with the least number of reflectors and cover glasses has been placed on the market by the Benjamin Electric Manufacturing Company, Des Plaines, Ill. These floodlights are so designed that the spread of the beam may be varied through a wide angle and the number of different types of projectors is reduced to a minimum, so that the selection of the right projector is simplified.

A distinctive feature is the spring-cushion method used to hold the silvered glass reflector in position in the housing. This cushion acts as a shock absorber and allows for the natural expansion and contraction from heat and cold.

Other features are a micro-focusing arrangement, easily operated; cover lamps and provision for rotating the housing in the yoke so that the hinges can be positioned to permit the most advantageous opening of the cover and also facilitate positioning of the ribbed glass cover where used.

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Automatic Oscillograph Records Short Circuits

TRANSIENT DISTURBANCES on electric power systems, such as accidental short circuits and similar phenomena, are recorded automatically by a new oscillograph announced by the General Electric Company. The instrument provides definite information of magnitudes of current obtained during accidental short circuits, thereby affording a check on short-circuit calculations, on the rupturing duty imposed on circuit breakers and on relay settings. The device also provides a continuous check on relay operation. With the advent of high-speed switching and relaying, it provides a precise means of keeping a continuous check on the actual speed of the relays and circuit breakers under operating conditions, and thereby the means for detecting and correcting any difficulties which may develop.

The oscillograph, designated as type PM-13-A1, contains six oscillograph galvanometers of standard construction and makes an oscillographic record on sensitized paper 4¼ in. wide. The feature of the instrument is its ability to start the record in less than a half cycle. The instrument is designed for mounting either on a table in the usual way or on a switchboard panel.

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A COMPLETE NEW LINE OF SCREW RING RECEPTACLES, including screw terminal, loop terminal and wire lead type, is announced by Cutler-Hammer, Inc., Milwaukee, Wis. The body is made of heavy walled "Thermoplax," which is shatter-proof and does not chip easily, thus reducing breakage in handling and installing and giving a more clean-cut appearance. The screw ring is of porcelain to harmonize with other devices if used as replacements. The copper screw shell can be removed easily and quickly from the front of the sign. The large terminal screws are staked to save time and prevent loss.

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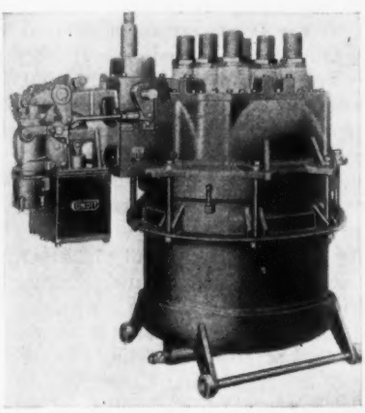
Breaker Has Capacity of 14,000 Amp. at 15,000 V.

AN INDOOR OIL CIRCUIT BREAKER, known as type DR-140, offering such features as all poles on one tank, totally inclosed mechanism, gasketed joints between tank and frame, oil and gas separator and expulsion type contacts, has been announced by the Condit Electrical Manufacturing Corporation. Some of the advantages of these features include small space requirements, quick-clearing operation and freedom from oil throwing.



It is furnished three pole, electrically operated, for 600, 1,200, 1,600 and 2,000 amp. at 15,000 volts and 3,000 amp. at 7,500 volts. It has an estimated interrupting capacity of 14,000 amp. at 15,000 volts. It is also furnished manually operated in the lower ampere capacities.